TECHNOLOGY DEPT.

Gas Journal

VOL. 287. 108th YEAR. LONDON, AUGUST 15, 1956. No. 4857. PRICE 1/6

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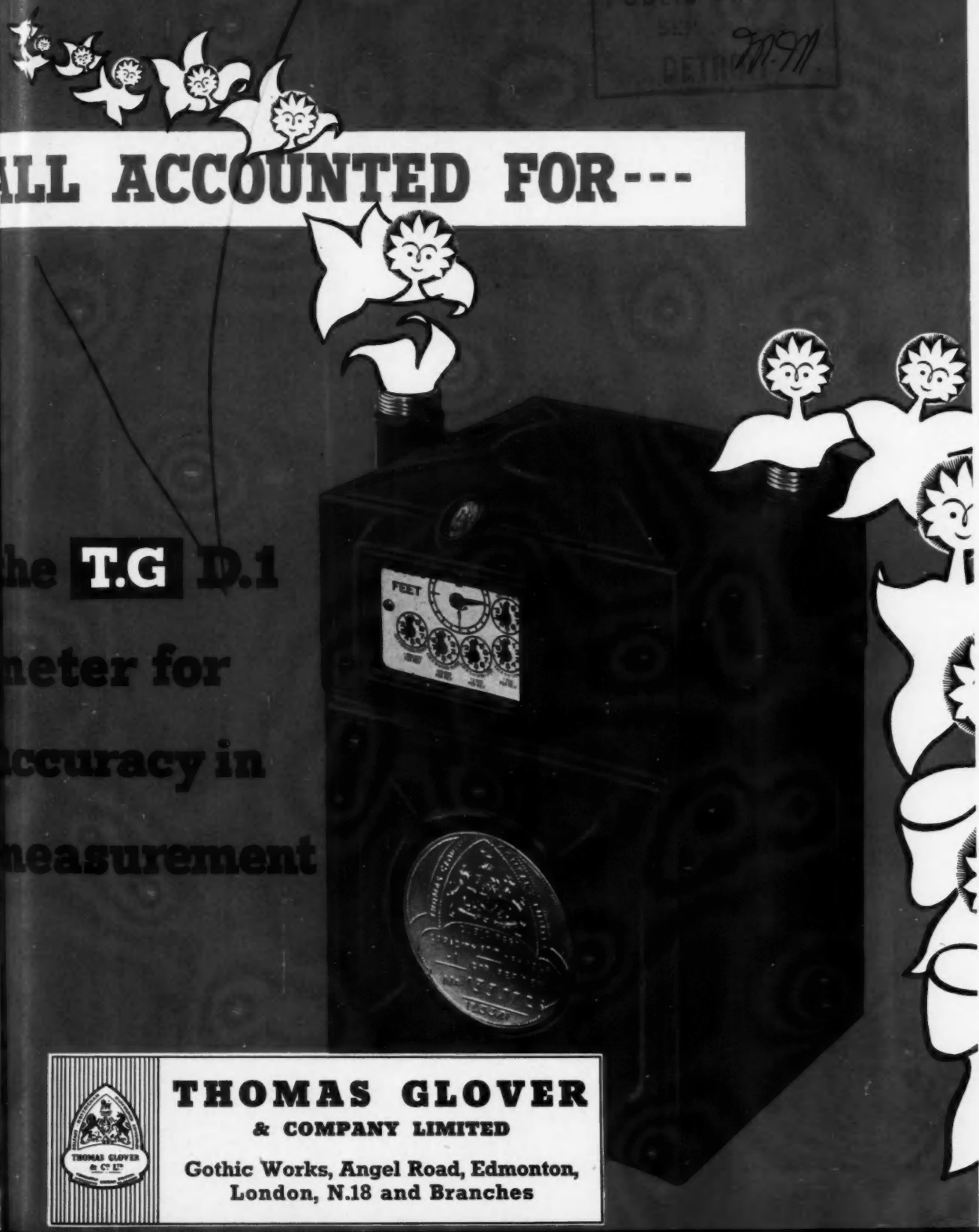

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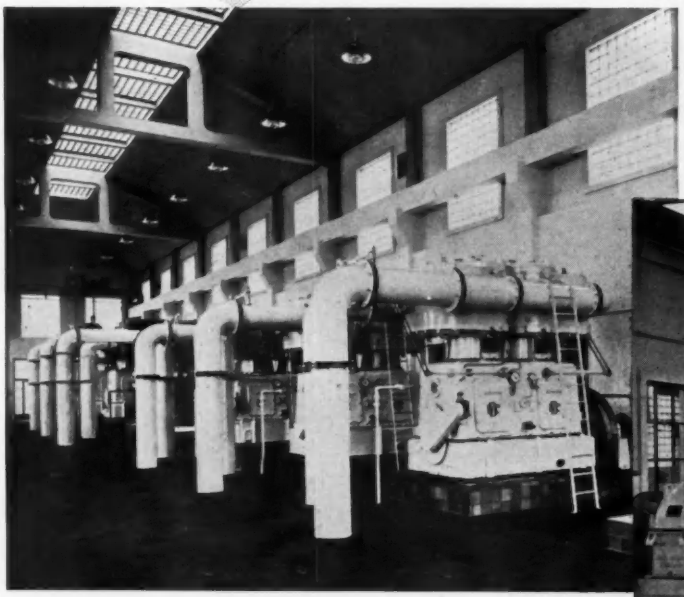
For the Big Jobs...

20,000,000 CUBIC FEET OF GAS PER DAY

The Compressor House at Partington, Manchester Group of the N.W.G.B., holding six complete sets of Gas Compressors. Each machine driven through speed reduction gear units arranged through gas tight wall glands



BASE YOUR DECISION ON APPLIED EXPERIENCE AND EFFICIENCY

Photographs by courtesy of N.W.G.B.

Illustrations show the interior of the Compressor House comprising:
3 – Gas Compressors – 22½" dia. x 12" stroke (2 variable speed and 1 constant speed), each capable of 160,000 cu. ft. per hour, running at 325 R.P.M. at 20 lbs. per sq. inch outlet pressure. 3 – 37" dia. x 14" stroke (2 variable speed and 1 constant speed), each capable of 500,000 cu. ft. per hour running at 290 R.P.M. at 10 lbs. per sq. inch outlet pressure. 1 – Future machine 26½" dia. x 12" stroke (constant speed), 250,000 cu. ft. per hour running at 325 R.P.M. at 10 lbs. per sq. inch outlet pressure.

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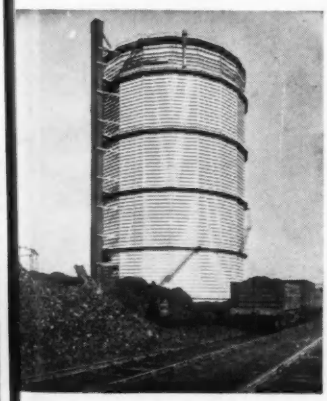

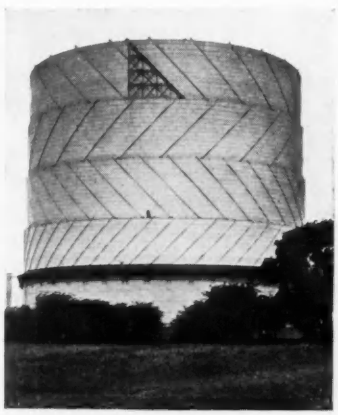

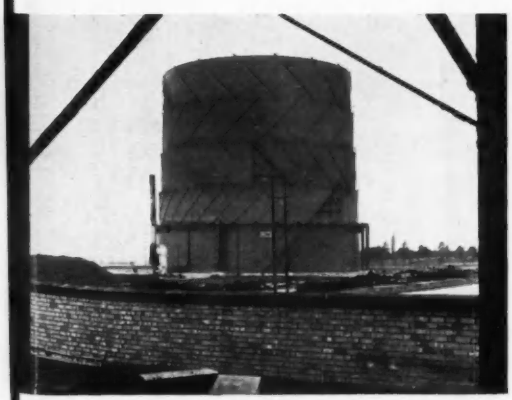

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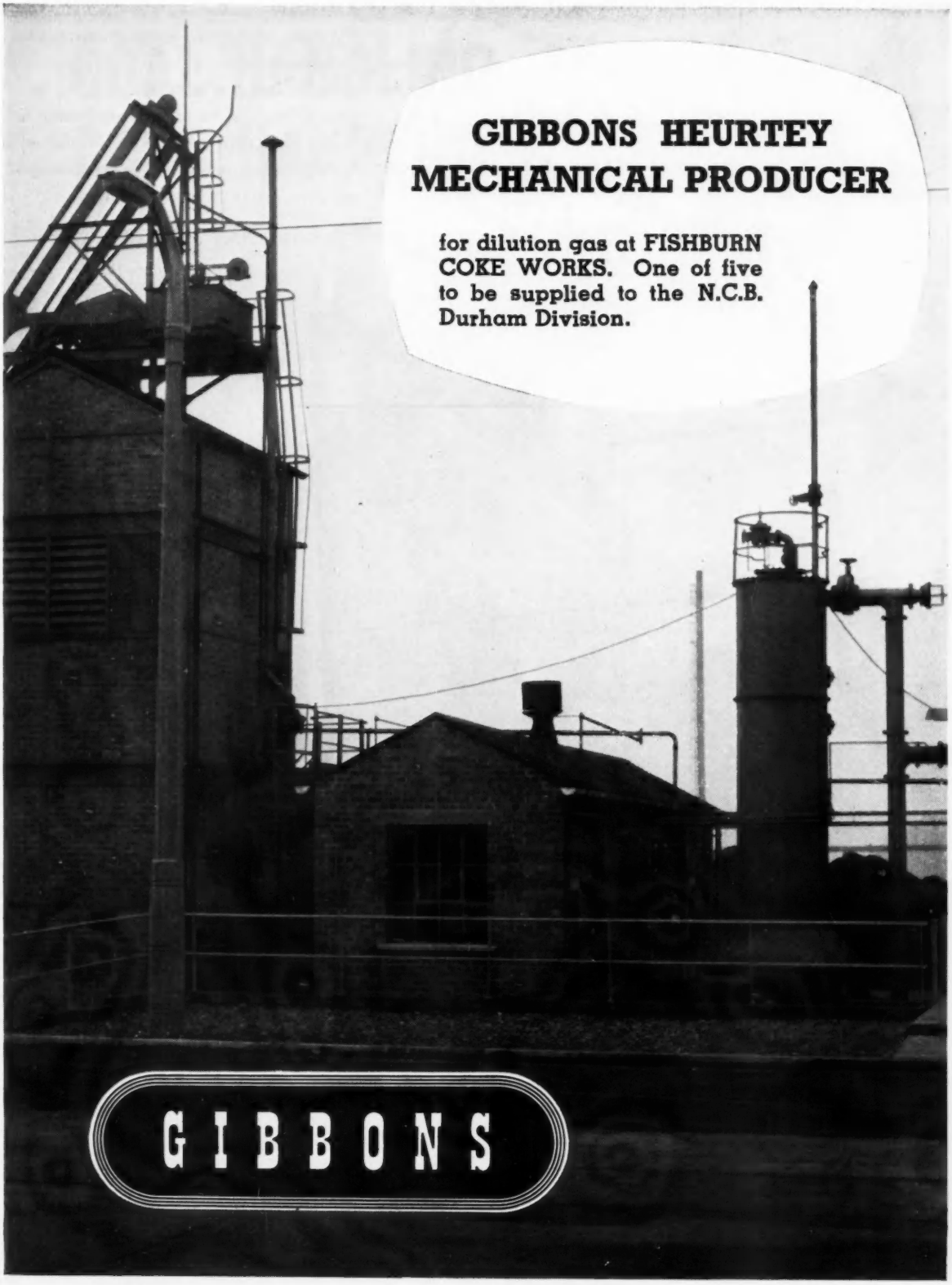
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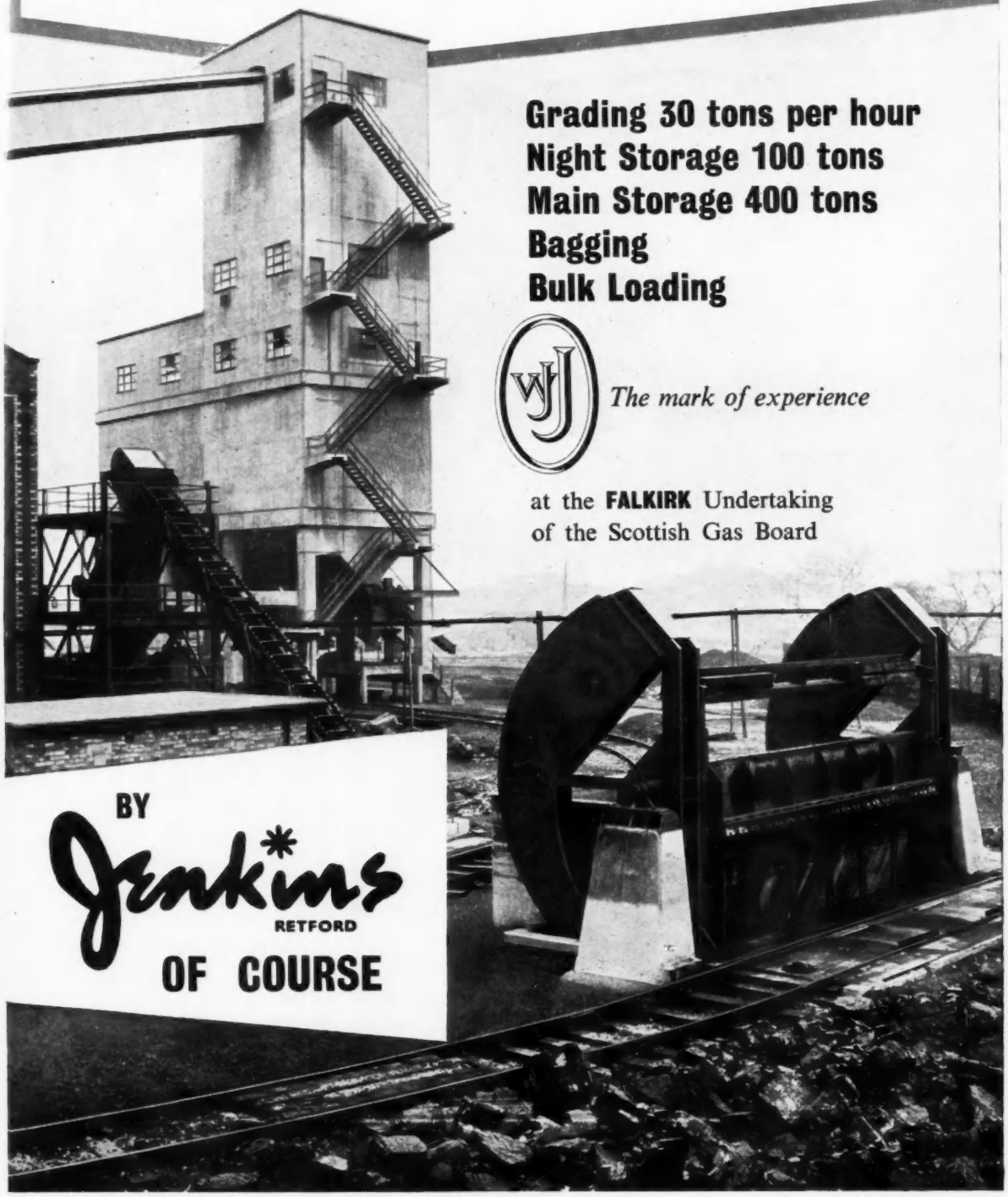

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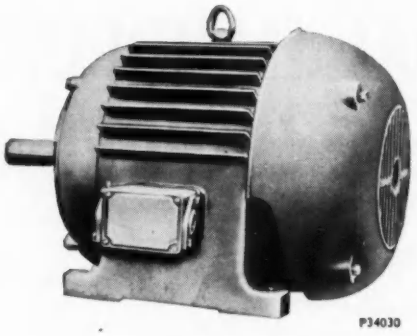
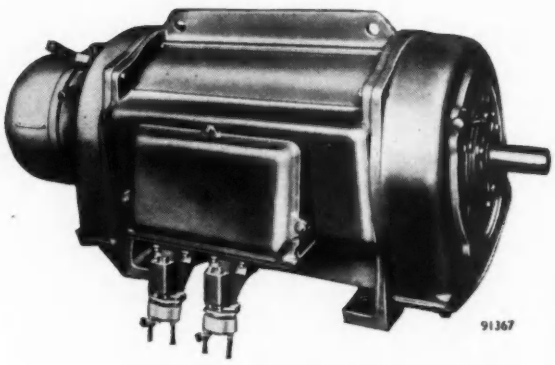
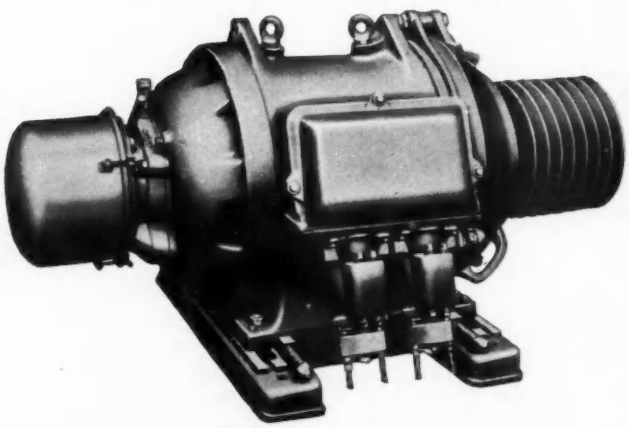
Flameproof motors are also available when required.



Metrovick type KZ squirrel cage totally enclosed fan cooled motors are available up to 40 hp.



100 h.p. and above type HRW high speed (2,960 rpm) drip-proof slipring motor.



100 h.p. and above type RW totally enclosed fan cooled slipring motor.

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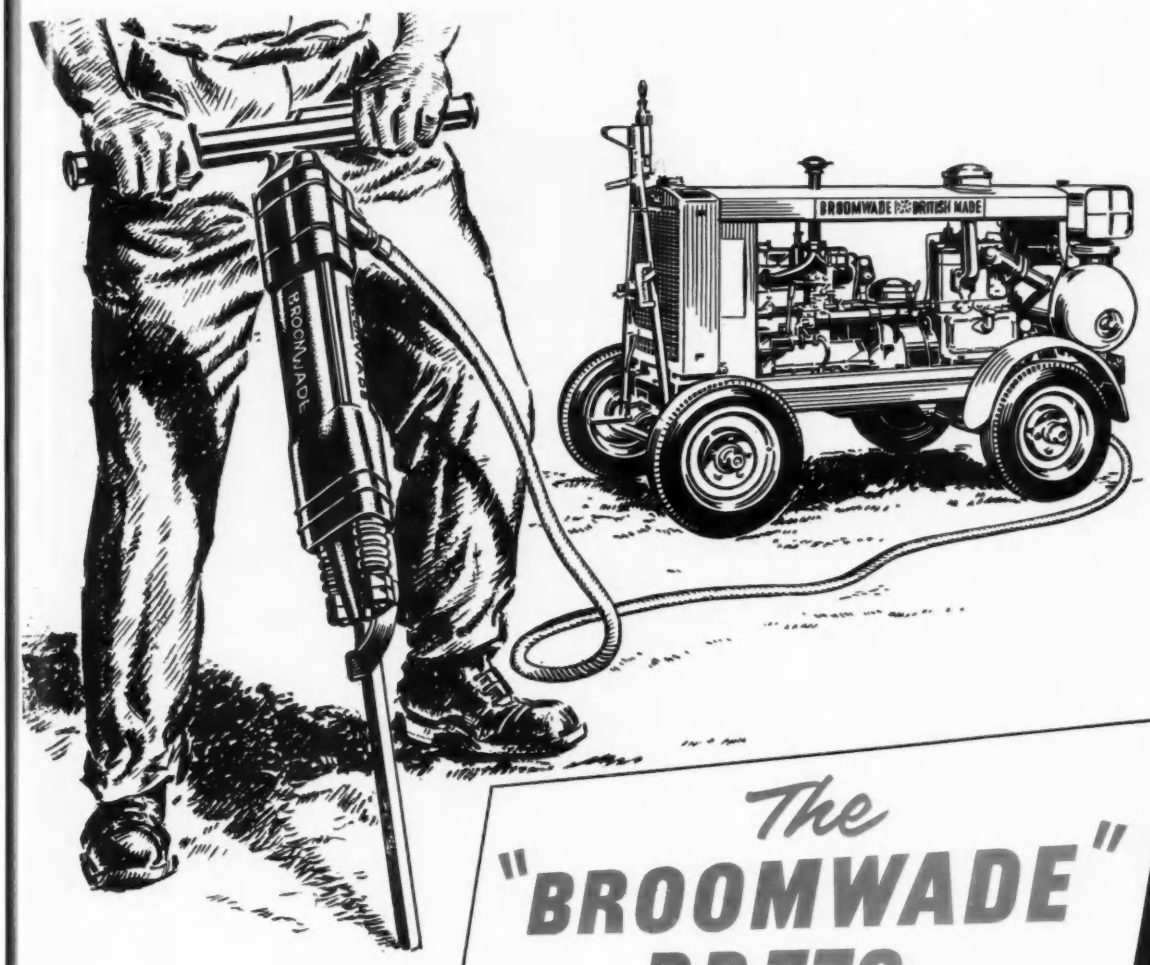

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The RB 770 is a long stroke, hard hitting tool which has been specially designed for the TOUGH JOB.

It is perfectly balanced and weighted to give constant maximum operation without fatigue to the operator.

This tool has been tested under the most arduous conditions and the results have exceeded even our own expectations.

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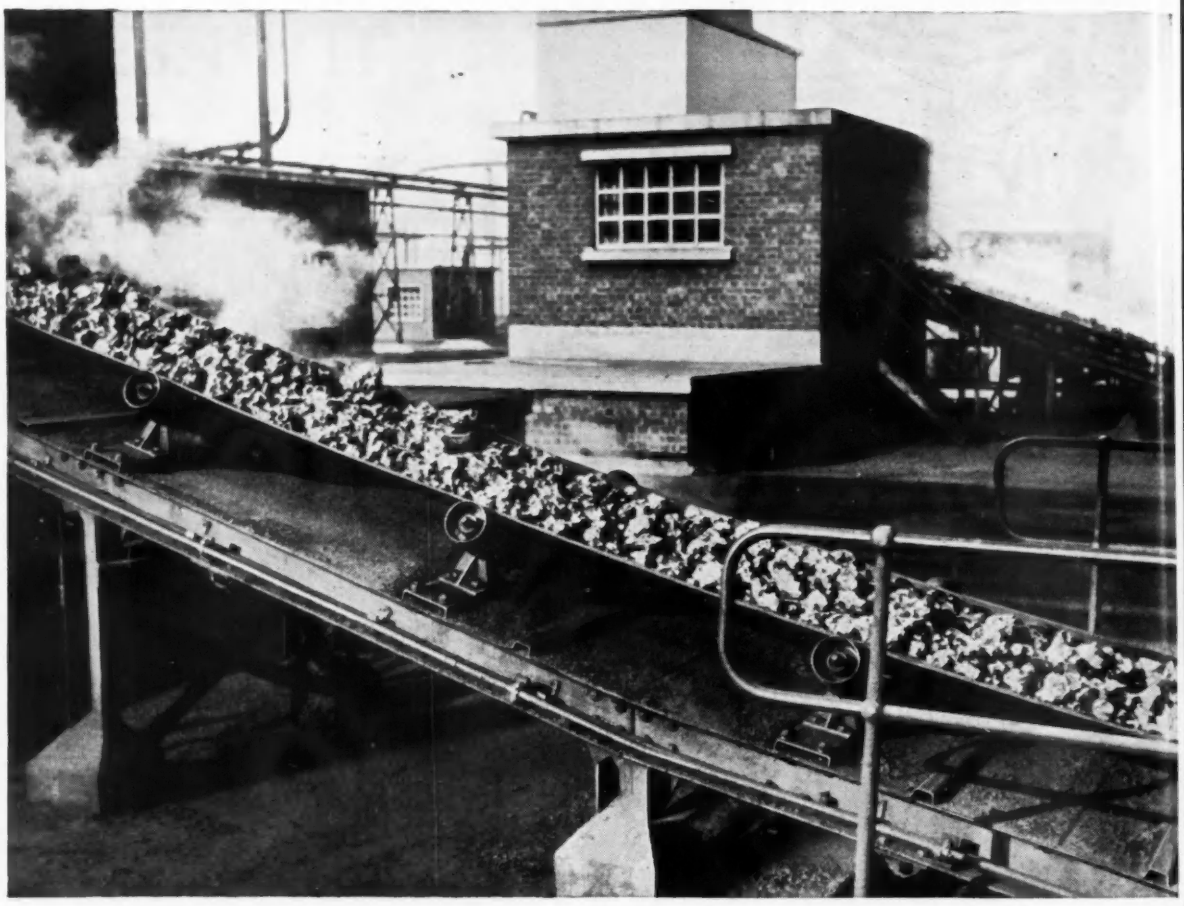

BTR conveyor belting

-throughout the works

BTR

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One reason why so many gas works, like Bromley-by-Bow, are equipped throughout with BTR belting is that conveyor and installation engineers prefer it. They know from experience that BTR belting settles down quickly—complements the efficiency of their conveying systems. The gas engineer, above all, benefits from the trouble-free performance and low belt maintenance costs associated with BTR conveyor belting.

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MONOLITHIC PIPE LININGS

Examples of another of the many uses for

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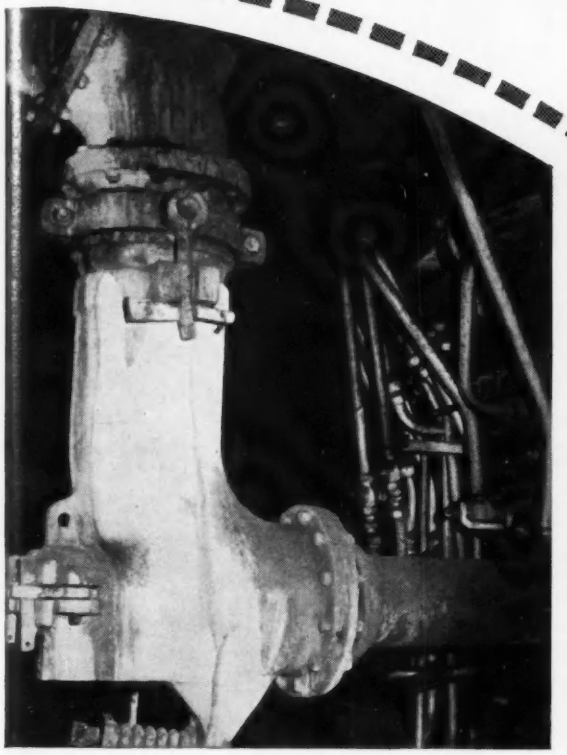
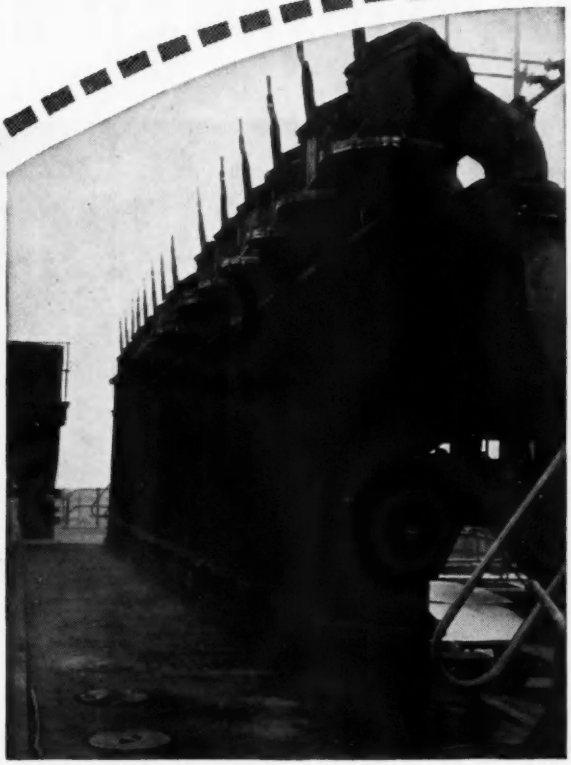


Refractory Concrete-lined Goose necks in position on blast furnace from bustle pipe to tuyere



A battery of refractory-concrete-lined ascension pipes in service.

Not only because of its great economy and ease of placing, but, being completely non-spalling and highly resistant to scour, it forms a really lasting non-collapsible rigid lining for foul mains, ascension pipes, bustle pipes and similar hard duty applications.

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We will gladly forward on request a list of suppliers of crushed firebrick and other refractory and insulating aggregates, and of manufacturers of ready-prepared castable mixes incorporating CIMENT FONDU, to which only water need be added to make REFRACTORY CONCRETE.

Coke oven ascension pipes showing Refractory Concrete lining.

REFRACTORY CONCRETE
The adaptable Refractory material made with crushed firebrick and CIMENT FONDU

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You are invited to write for further details and photographic examples

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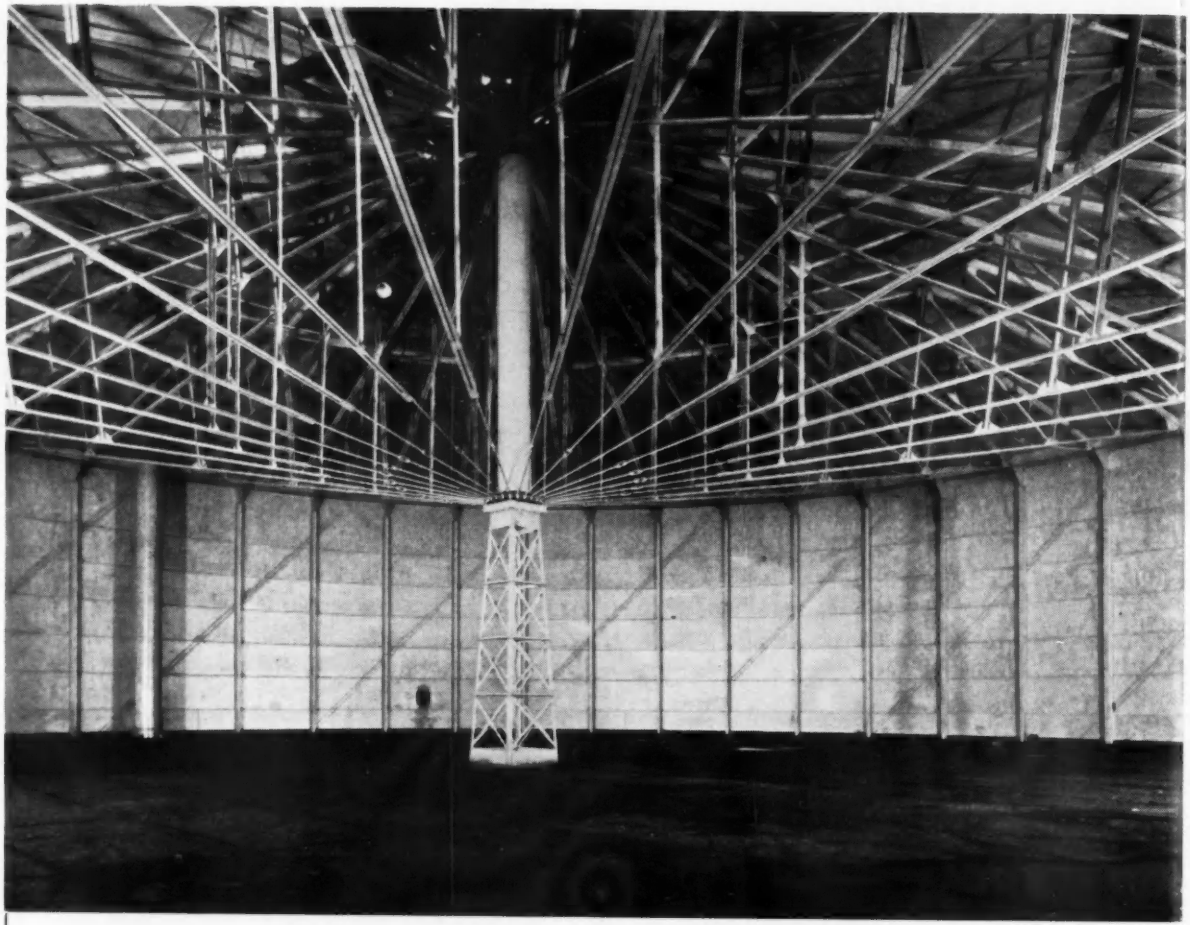

INTERIOR VIEW OF A "CLAYTON"
PATENT ALL-WELDED GASHOLDER

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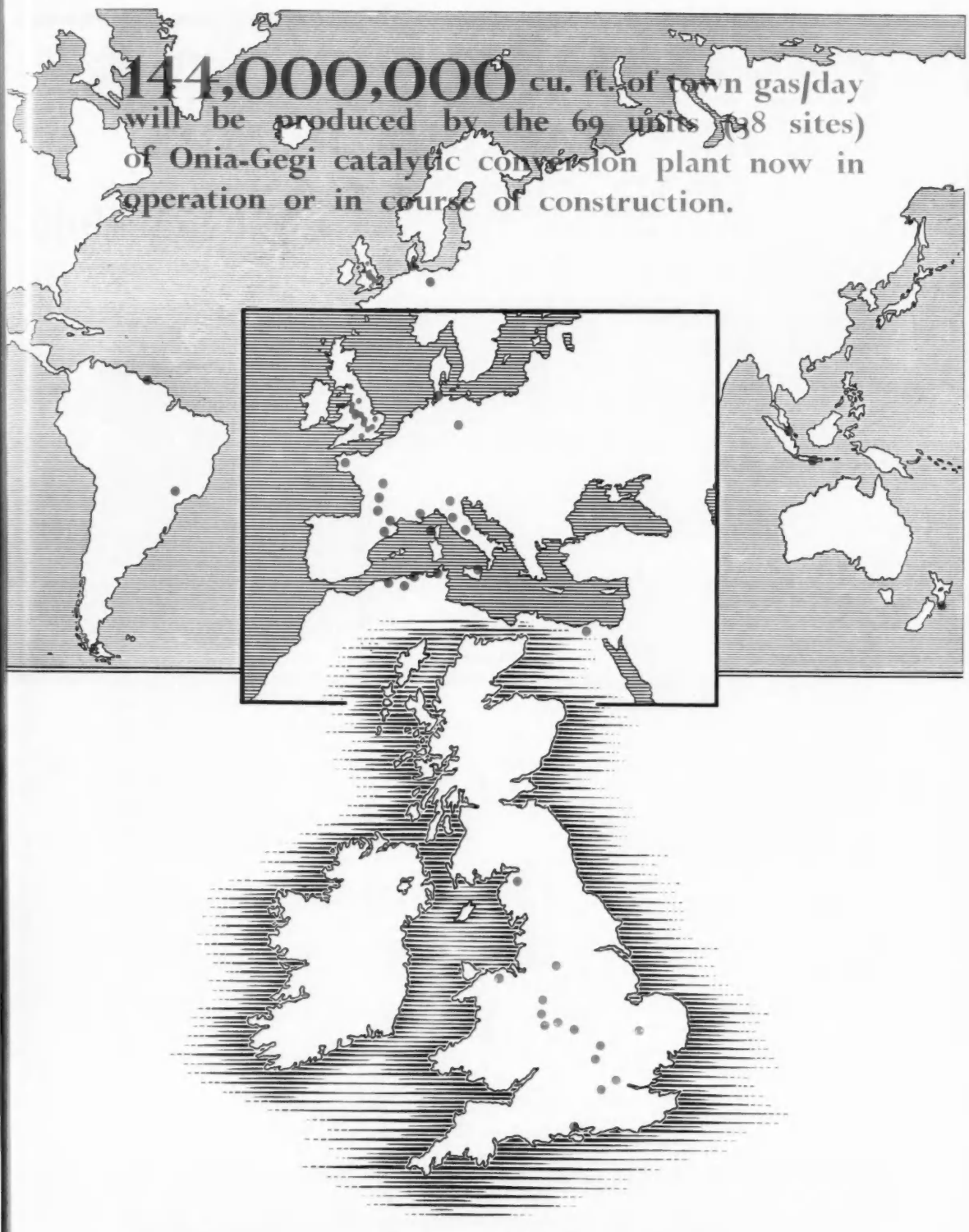
144,000,000 cu. ft. of town gas/day
will be produced by the 69 units (38 sites)
of Onia-Gegi catalytic conversion plant now in
operation or in course of construction.

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& DRY VACUUM PUMPS
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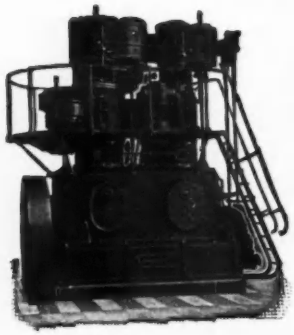

These double-acting cross-head type Compressors are provided with forced lubrication. They may be driven by any suitable power unit, as shown below, or by steam cylinders in tandem with the compressor cylinders making a self-contained unit, as shown on the left.

Single Stage. Pressures up to 40 lbs. per sq. in.
Capacities up to 10,000 cu. ft. per min.

Two Stage. Pressures up to 120 lbs. per sq. in.
Capacities up to 5,000 cu. ft. per min.

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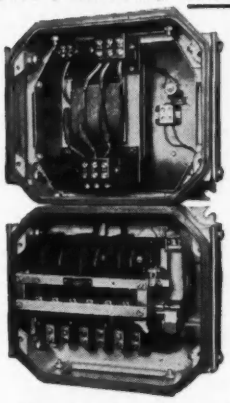
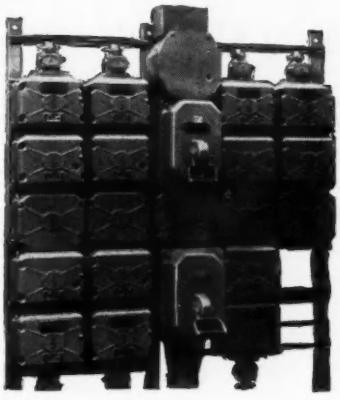
INCORPORATING AUTOMATIC CIRCUIT BREAKERS IN EACH OUTGOING WAY



A triple pole 30 amp. Circuit Breaker with core balance transformer and E.L. relay.

A typical multi-way board. Individual panel isolators also available.



UNIQUE for its Core Balance Leakage protection.
UNIQUE as an Ironclad distribution with automatic protection for normal overloads and short circuits.
UNIQUE on individual ways of power and lighting circuits with Earth Leakage protection for current ranges of up to 15 amps. and up to 30 amps. on low and medium pressure circuits.
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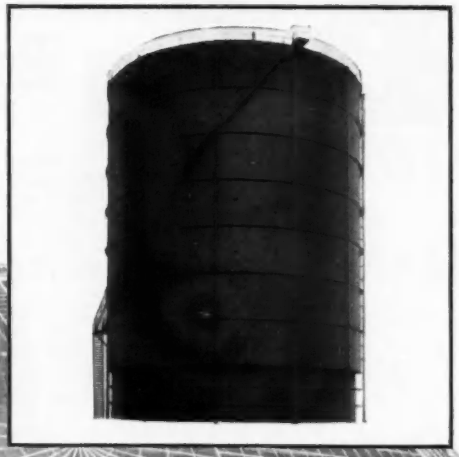

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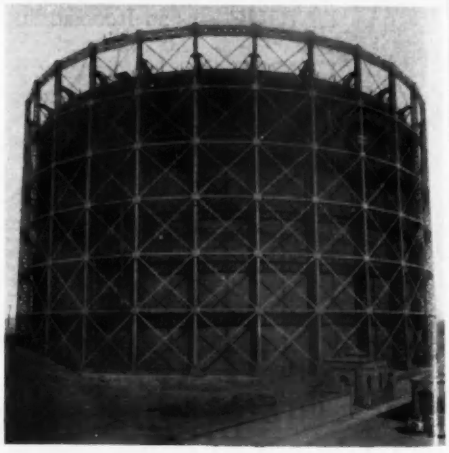

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THIS is our famous FIG. 199 unspillable stand-up Pressure Gauge fully patented

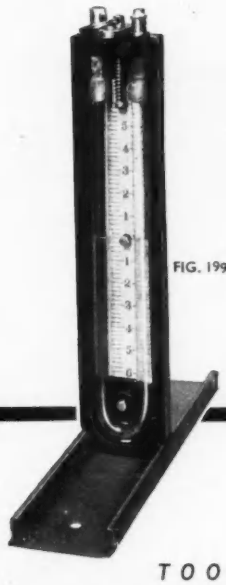

FIG. 199

The ideal pressure gauge for soundness testing of all pipe systems, and for checking gas pressures.

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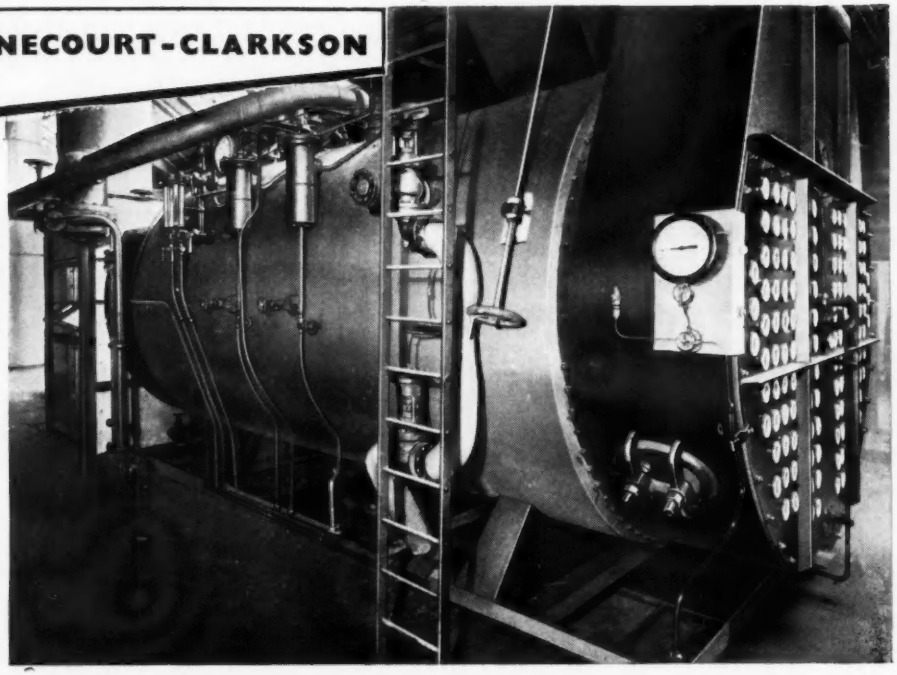
SPECIALISTS IN WASTE HEAT RECOVERY PLANT



The illustration shows one of the Spencer-Bonecourt waste-heat boilers at Stoke-on-Trent Gas Works. Similar units are installed on all the Glover-West Continuous Vertical carbonising plant in this works.

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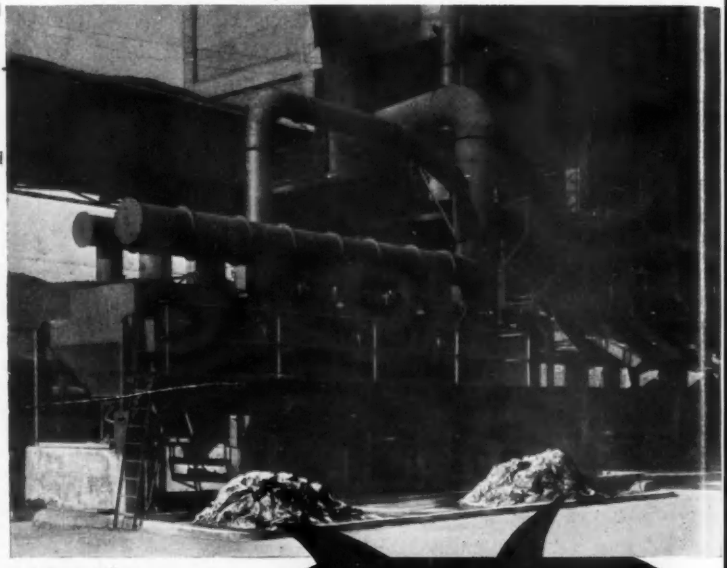

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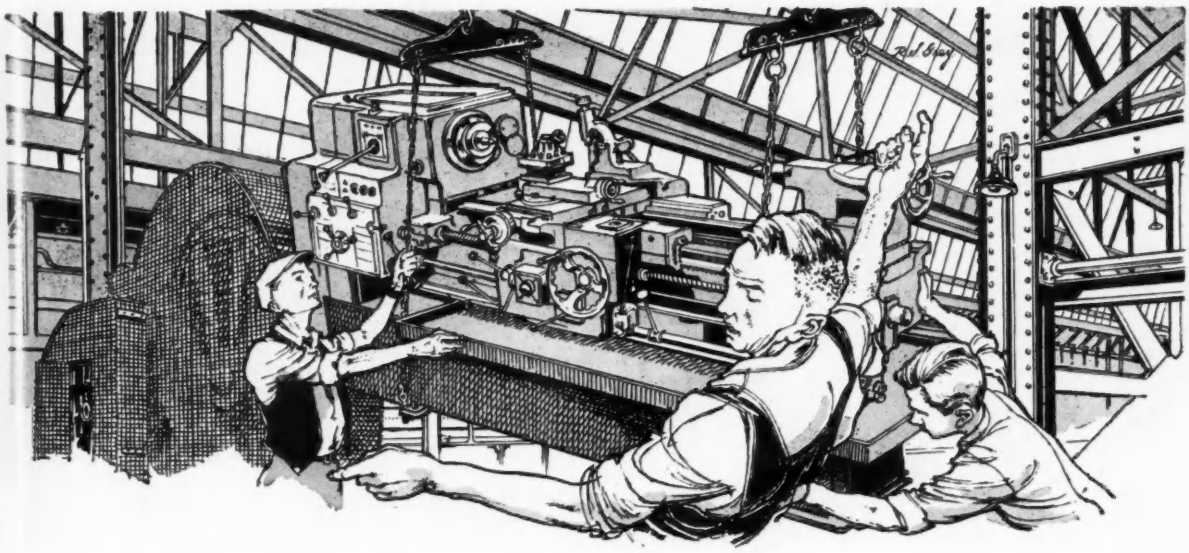

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"Moving house" for industry has long been the concern of Wards' Factory Planning and Installation Department. No job is too small or too large for them to handle, from the re-siting of a single machine to the planning and installation of a complete new factory layout.

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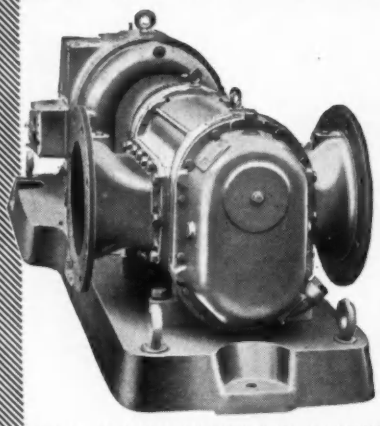

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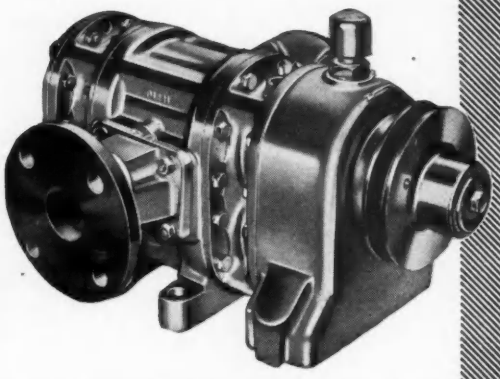

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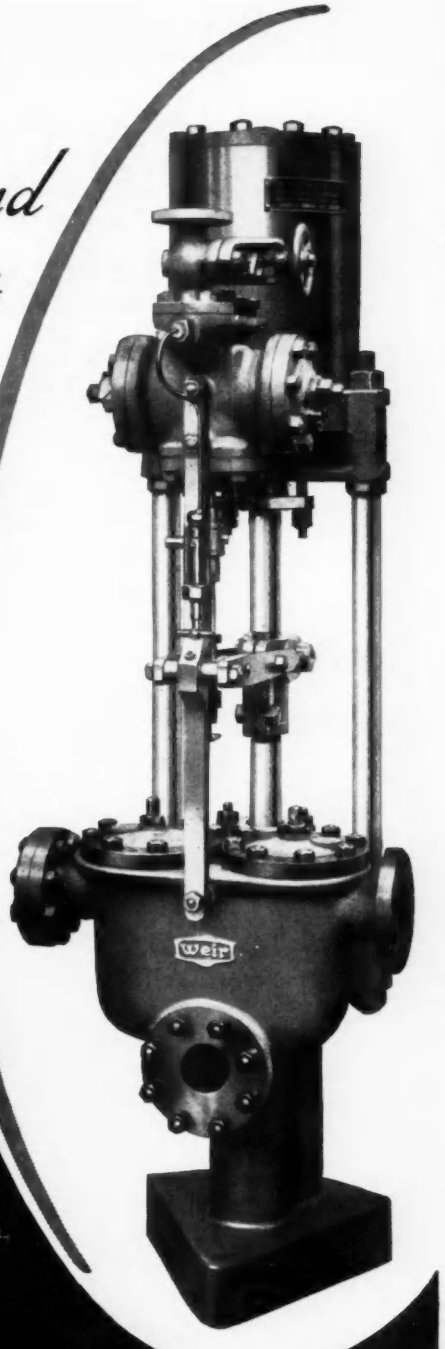

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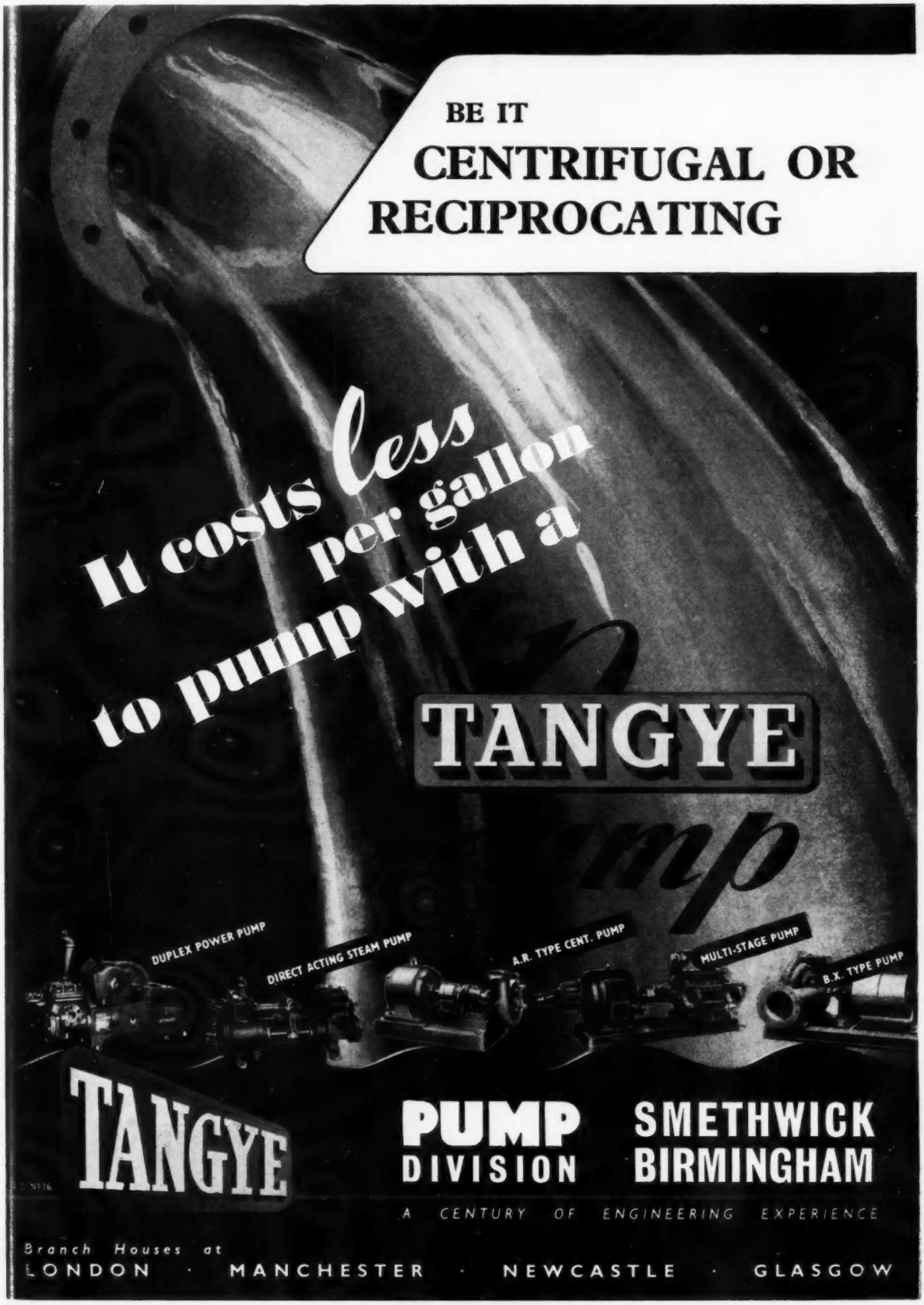
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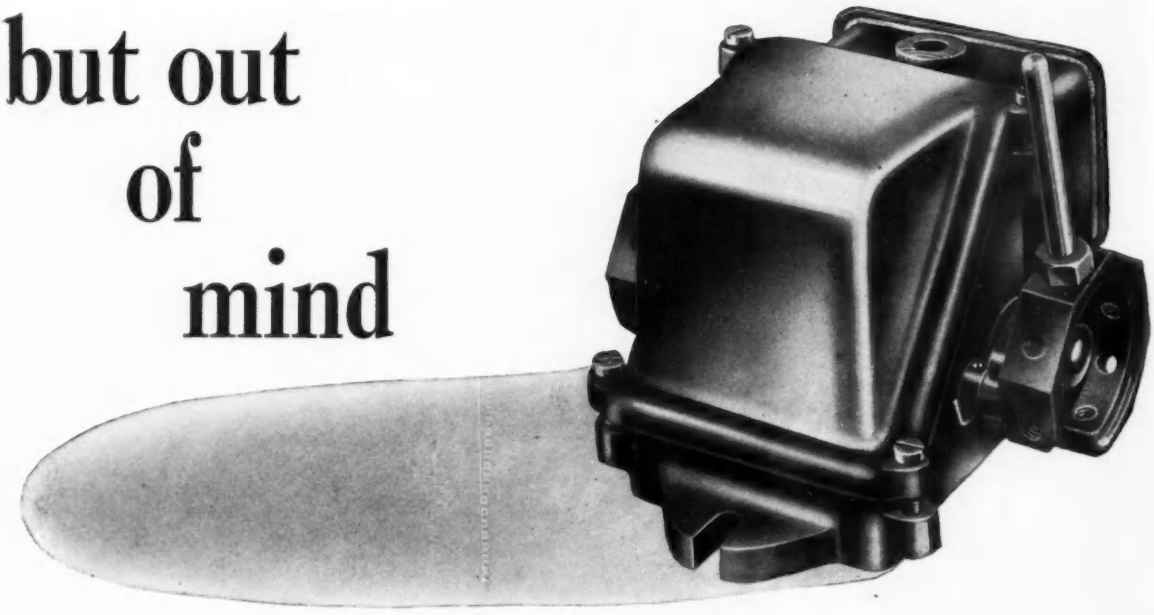

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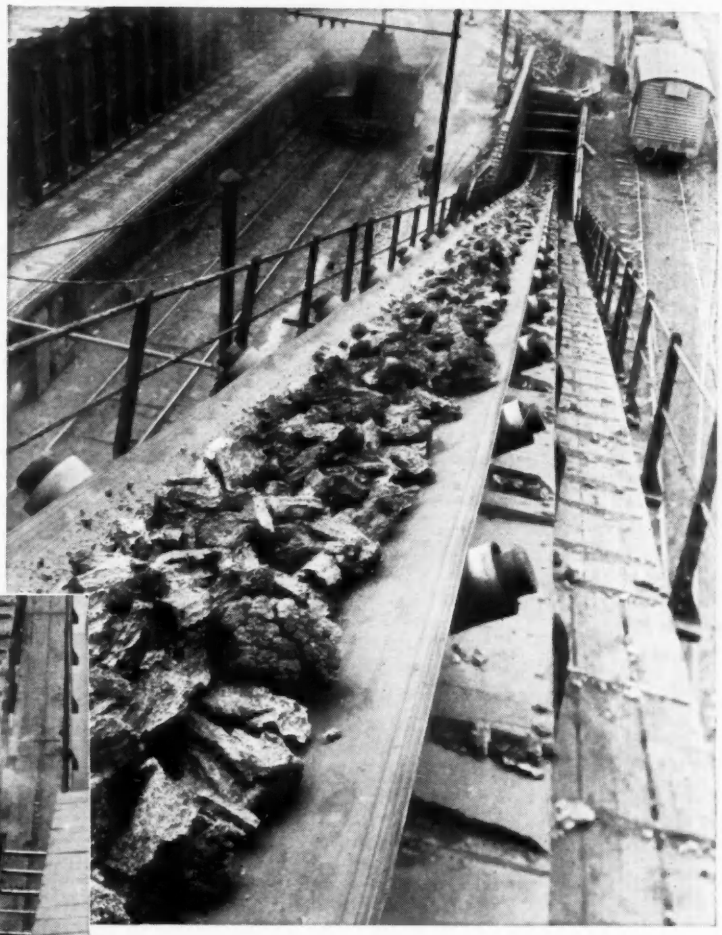

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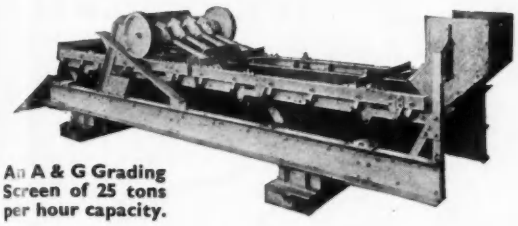

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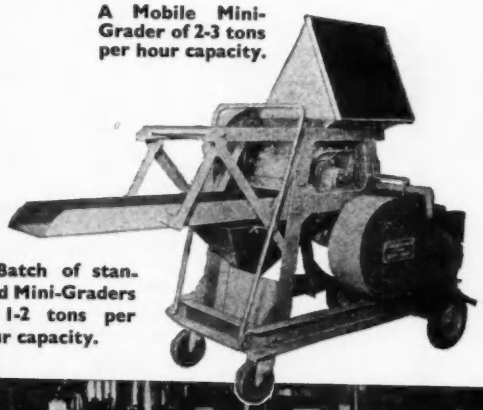

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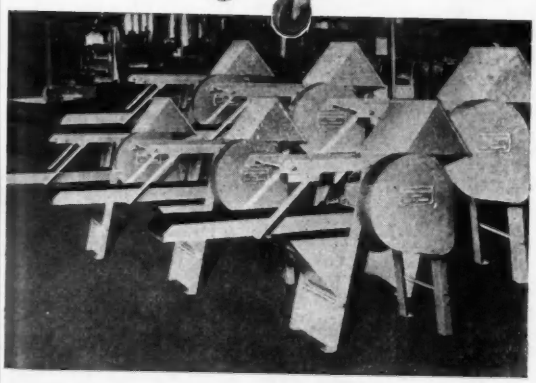

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Gas Journal

VOL. 287 *NO. 4857* *August 15, 1956*

108TH YEAR

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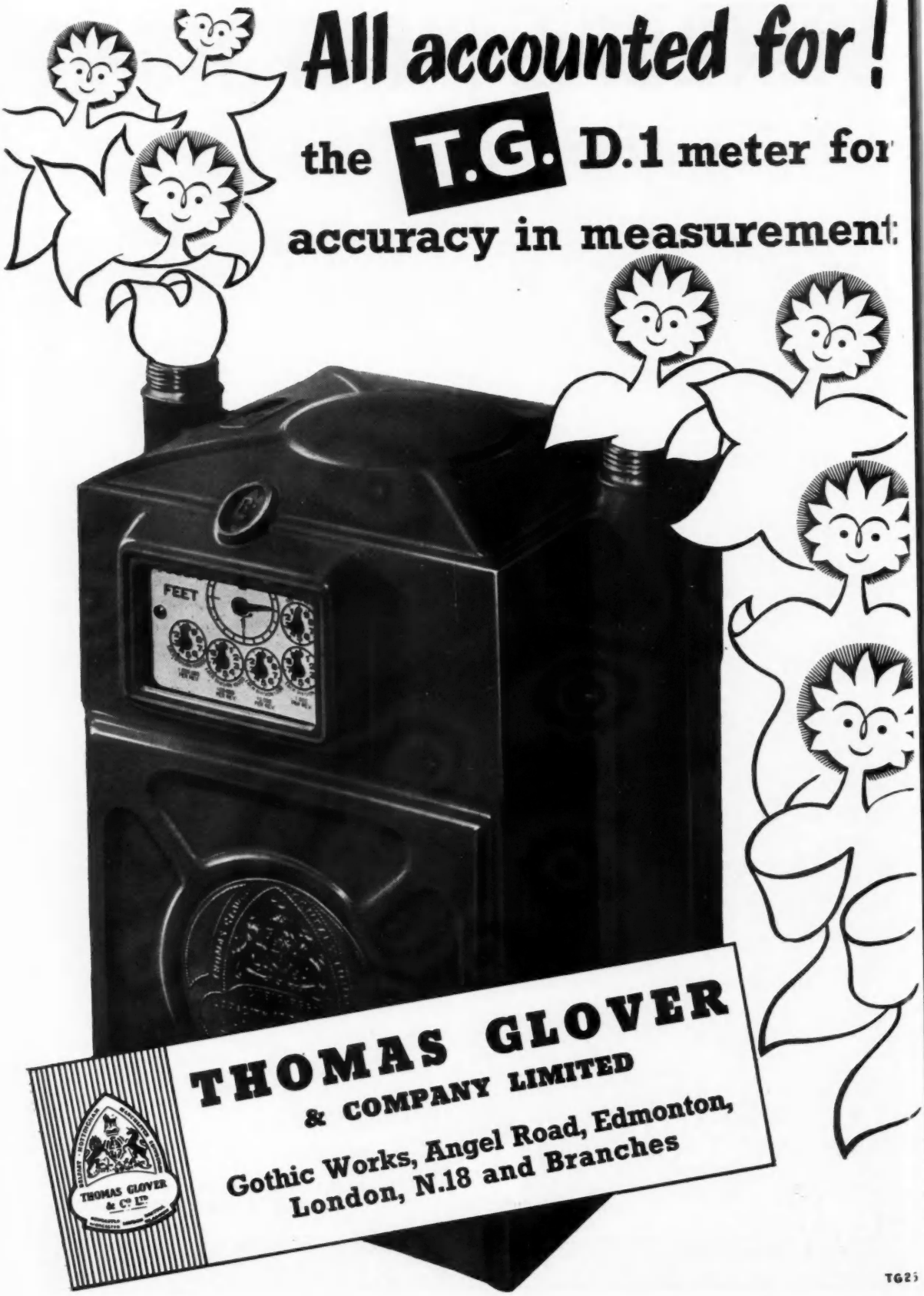

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Gas Journal

VOLUME 287. No. 4857. AUGUST 15, 1956. 108th YEAR

Putting Coke Over

FROM time to time we have discussed in these columns the part which should be played in the future fuel set-up by coke—how it should be constant in quality, available when wanted, and in general live down the prejudice against it which exists in some quarters. We have sought to examine how all this can be brought about but we have paid comparatively little attention to the important matter of putting coke over to the public. Of course, that aspect of things is just as important as satisfactory production and quality and it seems to us that it is an aspect which is being somewhat neglected. There is no reason to suppose that demand for coke will continue on its present scale if alternative fuels or methods of burning them become available. In recent weeks we have referred to the experimental work proceeding at Stoke Orchard, which, if successful, could result in a keen competitor to coke arriving on the scene in quantity. In other directions efforts are being made to popularise the burning of bituminous coal smokelessly in appliances ostensibly designed to bridge the gap between current 'smokeless air' requirements and the time when sufficient supplies of solid smokeless fuels become available. Radiation Ltd. have recently produced a little booklet 'in the public interest' entitled *The Clean Air Act and You* and although this is refreshingly free from advertising matter Dr. Harold Hartley took its launching ceremony as an opportunity to campaign for the acceptance by local authorities and householders of the closed type of downdraft appliance which, it is claimed, will burn coal with the emission of no more smoke than is produced with some of the prepared smokeless fuels used in open grates.

Quite clearly the implication was that the required quantities of solid smokeless fuels might be a long time coming, if they came at all, and even if they did not smokeless air (and Radiation) would go on. If a shade cynical, this attitude was undeniably businesslike and, it may well be, very realistic.

The point we are trying to make is that the future smokeless age may be less dependent on coke than was envisaged by the Beaver Committee. That being so, there is a need to publicise coke at the present time notwithstanding the fact that, in general, demand exceeds supply. How then is coke being presented to the public and to the traders who could, if they so desired, put the emphasis on coke-burning appliances and on the general advantages to be gained by coke usage?

There are, of course, the normal advertising media of newspapers, magazines and films, and certainly progress is being made along these lines. We wonder whether some lessons could be learnt from the outstandingly successful advertisements publicising Aga and Rayburn appliances. In these a considerable amount of information is imparted to the reader in an interesting and entertaining fashion, but throughout the emphasis is on cost. The substantial increase in coke prices a short time ago led to some bad publicity but we feel certain that those increases could be vindicated in a convincing fashion if the reader is made aware of the fact that coke is essentially a *prepared* fuel and copy written which relates the service given by coke to the householder's pocket. Of course, coke advertisements are prepared at two different levels—by the Gas Council and by the area boards—and there would seem to be good reason for supposing that at the latter level there is a certain lack of uniformity in approach.

Last week we attended the Press screening of the Gas Council's latest addition to its comprehensive and excellent film library. In 'New King Coke' a brave and determined effort has been made to inject interest into what can so easily become a dull subject. Using puppets and human beings side by side Film Workshop Ltd., have produced for the Gas Council the story of a woodcutter who has discovered the advantages of burning charcoal in order to obtain heat without smoke by making a journey in time to the twentieth century, where he learns of the many purposes for which the modern

version of his smokeless fuel is used. His knowledge of why coke is so popular enables him to convince the Royal Household of his day of the value of his smokeless fuel when he returns to his own time in history. The film benefits from a first-class script which succeeds in making some good fundamental selling points. Moreover it shows convincingly the clean and efficient service to be obtained from coke usage and it combines these with an entertaining story which will neither bore the adult nor pass over the heads of a younger audience. It left us wondering whether perhaps there was a case to be made for producing what might be termed a 'straight' coke film showing by means of good colour photography the advantages of the fuel and also getting over some of the do's and don'ts of using coke. By this means it might be possible to obviate some of the complaints which unfortunately take up a fair proportion of any coke officer's time.

These are only some of the ways in which coke can be publicised and there remains scope for improvement in other ways. For example, we have recently had an opportunity of testing the Gas Council's Approved Coke-burning Appliances Handbook and have found that a number of appliances therein are no longer in production and have been superseded by others, some of which are not yet on the approved list. Even more surprising, we have found that some manufacturers appear to be uncertain about whether their appliances are approved or not—and indeed seem to care very little one way or the other. Moreover, confusion exists between the Gas Council's approved list and that of the Coal Utilisation Council and the Solid Smokeless Fuels Federation. It is, of course, very necessary to have a list of approved coke-burning appliances but we suggest that greater efforts should be made to keep it up to date and to impress its importance upon those who have an opportunity of using it.

Ethylene

ETHYLENE is the first member of the family of hydrocarbons known as the olefins, or to put it more precisely and scientifically, the hydrocarbon of lowest molecular weight of the homologous series C_nH_{2n}. The chemical formula of ethylene is C_2H_4, and not CH_2, as one might expect if C=1, as this would be chemically impossible. To the gas engineer ethylene is merely one of the 'unsats,' which indeed it is, and when a gas analysis is being made by the works chemist it is always entered in his report under the general heading of C_nH_m. The calorific value of these gases is extremely high and varies between 1,560 B.Th.U. per cu.ft. for ethylene to 3,040 B.Th.U. per cu.ft. for propylene. In ordinary coal gas the total proportion of 'unsats' is very small and does not exceed 3.0%, and in coke oven gas it may be as low as 2.5%. This low percentage of olefins, however, is not found in gases made from oil by thermal cracking, and this is specially true of the production of gas by the Semet Solway process. This process has not yet made its appearance in this country but we understand that a plant has been built in Australia and several in America.

The chief difference in the gas formed by thermal cracking is that its calorific value is high compared to a similar gas made by catalytic cracking and so is in no way comparable with the standard town gas as distributed in this country. This gas has, however, a very high proportion of 'unsats,' which may be anything up to 35%, which would include 25% of ethylene by volume of the original gas.

To make this gas usable as town gas, it must be reformed, but in so doing a gas of about 275 B.Th.U per cu.ft. is the result. This gas then must be upgraded by the addition of some rich gas from the original cracking plant to bring it back to a calorific value of 450 to 500 B.Th.U. per cu.ft.

This may sound a very complicated procedure when catalytic reforming plants are available and working satisfactorily to do the operation of original cracking reforming and upgrading to town gas standards in one operation. But there are two distinct advantages to be gained from thermal cracking—the production of ethylene in sufficient quantity to make extraction worthwhile, and the almost total elimination of organic sulphur. These points were most ably made by Mr. W. J. Cutler in a paper to the Midland Section of the Institution of Gas Engineers some months ago, of which we published an extract in our issue of April 4 this year.

Ethylene is a very valuable raw material for the chemical industry and is in demand for the production of such plastics as polythene; the recovery of it not only brings the calorific value of the cracked gas down considerably and thus reduces the cost of reforming, but the sale of this valuable by-product actually pays for the cost of production of the town gas.

Mr. Cutler goes on to show how this is possible. He bases his calculations on a yield of 16.5 lb. of ethylene per 1,000 cu.ft. of stripped high C.V. gas and the operation of the recovery plant for 350 days per year. The size of the plant that Mr. Cutler has in mind has a throughput capacity of about 26 mill. cu.ft. of town gas per day available for distribution, but with ethylene extraction this would drop to about 17 mill. cu.ft. per day because of the reduced C.V. value of the stripped gas, and the smaller amount of gas to be reformed. The cost of making this 17 mill. cu.ft. gas per day is calculated at a total, inclusive of depreciation, interest, maintenance and supervision as £6,926. The realisable value of 11,625 gal. of light oil at 1s. 3d. per gal. and 30,000 gal. of tar at 6d. per gal. as well as 88 tons of ethylene at £65 per ton, is £7,196. This will yield a profit of £270, before any gas is sold at all.

It is quite clear that the economics of the process depend on the supply of and demand for ethylene and the maintenance of its present price, though a slight fall in price would only reduce this very favourable profit margin. It seems that the demand for ethylene for the manufacture of polythene is increasing, as was shown by a recent announcement by I.C.I., Ltd., of an extension of their Wilton factory at Stockton for the manufacture of alkathene, which is their trade name for polythene. This firm is going to spend considerable sums on installing a third cracker plant together with an extension of their alkathene plant to 90,000 tons per year by 1959. Added to this, the patent for making polythene by the high pressure polymerisation of ethylene held by I.C.I. ran out this year, and other major companies have decided to enter the field, among them the U.S. firm of Union Carbide. This firm will have a factory operating at Grangemouth by 1957.

Although polythene is perhaps one of the best known derivatives of ethylene, ethylene itself is a basic raw material for a number of other chemical compounds used as intermediate products in chemical syntheses.

The New Mrs. America

IT will be remembered that in a recent issue of the 'JOURNAL' we referred to the search for a new 'Mrs. America.' The result of the competition, which was sponsored by the American Gas Association, was announced a few weeks ago. Mrs. Cleo Maletis, of Portland, Oregon, 31-year-old mother of three children, collected winner's prizes valued at $15,000 in a ceremony witnessed by an audience of 3,000, while millions of listeners heard it over NBC's 'Monitor.' The contest was judged over a period of five days, during which the contestants were judged on homemaking and grooming abilities and their participation in social affairs. The average age of the contestants was 32, while the average family size was three children. 'Contestants no longer appear in bathing suits at any time,' states the *American Gas Association Monthly*. 'The Mrs. America contest reflects the American way of life, accenting the rôle of the family in each community. Thus the gas industry which sponsors the Mrs. America contest through gas companies in every part of the country, serving over 34 mill. families, seeks to encourage and reward the homemaker for her outstanding contribution to her family, her home and her community.'

The Mrs. America contest was started 18 years ago in Asbury Park, New Jersey, by Mr. B. Nevins, the Managing Director of Mrs. America Inc. Three years ago the American Gas Association became its main sponsor and since then the emphasis has been entirely on homemaking and social activities. The 49 contestants, drawn from the 48 states of America and the District of Columbia, were selected by their home states as representatives in the contest.

We gather that Mrs. Maletis, who in addition to being an expert cook and housekeeper, is an active figure in social activities and holds a master's degree in home economics, showed herself as a serious contender for the title from the very beginning by winning five special awards for individual achievement as against ten other contestants' two.

What about the husbands of these paragons? While contestants were showing their paces their better halves were enjoying themselves in a week of swimming, fishing, golfing, sightseeing, etc., because the contest ruling stated that husbands were not to assist their wives in any way during the competition. The contestants and their families lived in houses on Mrs. America Drive, Ellinor Village, Fla., during the last stages of the contest, under the wing of special hostesses. Upon her return home after winning the contest Mrs. Maletis was fêted by the dignitaries of her home town and appeared on Herb Shriner's 'Two for the Money' and 'Strike it Rich,' two television programmes viewed by millions of American citizens. Maybe we will have the pleasure of seeing Mrs. Maletis over here before long.

Good British Fare

A FEAST of good British fare will be presented to the public for three weeks from August 28, at Olympia, when the Gas Council contributes its part to the British Food Fair. Eighty experts in cookery—one of them a man—will prepare and cook hundreds of recipes which can truly be said to be a part of Britain's history. These experts will have come from all parts of the British Isles and have been chosen by the area gas boards to introduce visitors to an exciting selection of dishes from the wealth of traditional and regional cookery.

The Food Fair will be opened by the Minister of Agriculture. Demonstrations will be in progress every day in three periods, and each kitchen will display an attractive collection of cooked dishes. Some of the recipes are hundreds of years old and have been collected from nearly every county in the United Kingdom. From London come recipes from some of its boroughs. One spark of modernism has been brought into the proceedings by a team from the counties, for they present what are called 'television snacks.'

The fact that most of the recipes presented are still in common use by country housewives shows that tradition in cookery survives as long as any of the customs of old. They range over every kind of cookery from the simple breakfast, main meals, to cakes, sweets, biscuits and preserves. Most of them have little histories behind them and all are available to the visitors, many in a gaily printed booklet 'County Fair' which will be on sale at the Food Fair.

Visitors will be delighted with the original décor of the kitchens, the walls of which will be decorated with large-scale drawings in black and white illustrating the titles of traditional county dishes. These light-hearted sketches by the famous cartoonist David Langdon were specially commissioned by The Gas Council.

The kitchens will contain equipment that fulfils a housewife's dream. Colour is used with imagination and taste and unit furniture with ample cupboards and drawers set off the latest gleaming gas cookers, refrigerators and water heaters. The demonstrations will illustrate that whatever the recipe, traditional or modern, gas can produce the perfect dish.

The Gas Council is to be commended on the enthusiasm displayed over this event which will undoubtedly contribute valuable publicity to the gas industry.

Blarney?

WE were, of course, familiar with the age-old illustrated chestnut depicting a grim, forbidding female dragging her screaming brat into a frigid sea on a typical icy British summer's afternoon, and rasping as she does so: 'I brought you to the sea to enjoy yourself, and enjoy yourself you shall.'

What we didn't realise, however, was that mother and child in this ancient little drama are Northern Irish, and the uninviting beach on which they enact their dismal scene, somewhere along the shores of the Emerald Isle.

But now we *know*. For a correspondent's report has just been rushed on to the editorial desk telling of trouble brewing among the workers of the Newry gasworks. For years, we learn, these men have skulked and growled at mention of their annual outing. And—despite the fact that each year the Council Gas Committee has made the men a grant 'to help them to enjoy themselves'—the majority of them have for many years stubbornly refused to go. Till now, new problems have arisen and this year the men's refusal to enjoy themselves has raised the ticklish question: Should they be paid for not enjoying themselves?

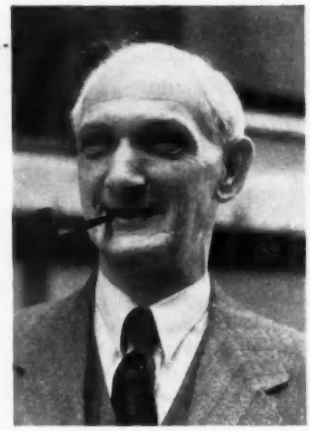
Strange to find this odd, irrational behaviour in the level-headed Ulsterman . . . . But soft: Newry is but a stone's throw from the Border. Travel five miles South—by road or rail, or swimming seawards down Carlingford Lough—and you land in Eire (sorry, Dublin readers, the Irish Republic). We now begin to see the light. This refusal on the part of Newry men to go out together and enjoy themselves is not indigenous at all. It is cunningly incited by subversive elements infiltrating North across the Border to sow dissension among the workers and disrupt the Ulster gas industry!

Or not?

Personal

MR. J. T. HAYNES

MR. JOHN TATTERSALL HAYNES, O.B.E., Divisional General Manager of the Western Division of the Southern Gas Board, is to retire at the end of September. Mr. Haynes was President of the Institution of Gas Engineers in 1953. He began his career in the gas industry in Lancashire. Commencing at Liverpool he became Assistant Engineer to the Lancaster Corporation gasworks after service in the Royal Engineers in the first world war. In 1921 he was appointed Assistant Engineer at Bolton Corporation gasworks and ten years later became General Manager of Rotherham Corporation gasworks. From 1936 to 1941 Mr. Haynes was Director and General Manager of Parkinson and Cowan Gas Meters and in 1941 he was appointed Engineer and General Manager of the former Bournemouth Gas and Water Company. His present appointment was made on nationalisation. He was awarded the O.B.E. in 1955. Mr. Haynes was not officially due for retirement for another year.



Mr. Haynes.

MR. FREDERICK DORRIEN HUCKLESBY has been appointed Superintendent of the process development section at British Oxygen's sales technical service department, Cricklewood. He joined the department in 1942 as an instructor in the firm's welding school, and later became Chief Instructor. In 1953, he became Senior Technical Assistant in the general service section.

MR. C. J. ATKINS, of Keith Blackman Ltd., has been appointed Sales Director. Other Keith Blackman appointments are: MR. F. W. GOODGE, as Contracts Director, MR. S. HUDSON, as Director and London Works Manager, and MR. A. H. WOODLEY, as Sales Manager. Keith Blackman manufacture 'Tornado' fan engineering equipment and industrial gas apparatus.

MR. G. ENSOR, Director of Fielden Electronics, Ltd., Wythenshawe, Manchester, has been appointed General Manager, and MR. VICTOR THOMAS has been appointed General Sales Manager responsible for all home and export sales and promotional activities.

MR. H. RAMSDEN, who for the past five years has been District Manager for the East Midlands Gas Board at Heanor, Derbyshire, has been appointed Local Manager at Mansfield, Notts., in succession to Mr. F. C. Sylvester, who retires on September 30. Mr. Ramsden, who is a member of the Institution of Gas Engineers, received his training with Halifax Corporation Gas Department and held posts at Harrogate, Stafford and Radcliffe before going to Heanor. Mr. Sylvester went to Mansfield in 1939 as Engineer and Manager of the Mansfield Gas and Water Department and when the gas industry was nationalised he was appointed District Manager for the East Midlands Gas Board.

MR. THOMAS ROBERTSON CAMERON, of Grangemouth, Stirlingshire, has been appointed Engineer and Manager of Coleraine Borough Council's gasworks in succession to the late Mr. W. R. Armstrong. A native of Stirlingshire, Mr. Cameron is a member of the Institute of Municipal Engineers and an Associate Member of the Institute of Fuel. He is at present Manager of the Grangemouth District, Scottish Gas Board, a position he has held since 1953. He will take up duty in Coleraine in September. Educated at Edinburgh Royal High School, Mr. Cameron has been employed in the gas industry since 1937, apart from the war when he served in the Royal Navy. He is a Past-President of the Scottish Junior Gas Association (Eastern Division).

MR. W. H. ELKERTON has been appointed Commercial Manager to the Southern Gas Board as from September 1, 1956, following Mr. A. F. Hetherington's appointment as Deputy Chairman.

COMMANDER COLIN BUIST has been appointed a Director of the Imperial Continental Gas Association.

£4 Mill. Orders Placed With Woodall-Duckham

WOODALL-DUCKHAM Construction Co., Ltd., announce that, in connection with the coke oven development project at Corby, they have so far received orders from Stewarts and Lloyds Ltd., to the value of some £4 mill.

Work will shortly commence on the first stage of this project, which will include the building of a complete new coke oven installation embodying about 50 ovens, coal blending and handling plant, by-product plant and coke screening and distribution plant.

Subsequent stages involving the rebuilding of existing ovens and by-product plant will follow in a sequence already planned by Stewarts and Lloyds Ltd.

Diary

September 4.—EAST MIDLANDS G.C.C.: Nottingham Chamber of Commerce, Smithy Row, Nottingham. 11.30 a.m.

September 4.—SOUTH EASTERN G.C.C., Caxton Hall, Westminster, S. W. 1., 11 a.m.

September 10.—NORTHERN G.C.C., 30, Grainger Street, Newcastle upon Tyne, 11.15 a.m.

September 21.—MANCHESTER AND DISTRICT SECTION, I.G.E.: Visit to the Works of W. J. Jenkins & Co. Ltd., Retford, Notts.

COUNCIL SEEK 'MINIMUM' REVISION

HEXHAM (Northumberland) Urban Council is to ask the Northern Gas Board to revise its minimum charge for supplying gas. Under a new arrangement, the lowest charge is 10s. a quarter even though the amount of gas actually consumed may be less than this figure.

The Council is to suggest that the rate should be altered to £2 per annum. This, it is stated, will make no difference to the Gas Board's revenue, but will benefit consumers who use little gas during the summer months.

Complaints about the Board's new minimum charge have been made in other parts of the north.

Fourteen Gas Ads. in One Alley

—Hot Water Only

THE 'Londoner's Diary' in the *Evening Standard* recently included the following paragraph: People who take a short cut to Epsom Town Station—along a narrow alley from the clock tower in the High Street to Station Approach—are calling it Gas Pan Alley. They pass a row of tall advertisement hoardings. 'Gas for cheap hot water,' says the first announcement. The second says the same. So do the rest. There are 14 of these signs. All are identical. Alderman J. A. Larby, a former mayor of Epsom and Ewell, and a member of the South Eastern Gas Consultative Council, plans to ask questions about Gas Pan Alley at the next meeting.

The British Malleable Tube Fittings Association announces that all its members, representing the great majority of British manufacturers of malleable tube fittings have re-affirmed the policy which they decided upon earlier in the year, by which they will not increase their prices during the remainder of 1956, unless forced to do so by appreciable increases in such production costs as are completely outside their control.

Gas and Coke at the Great Yorkshire Show

THE North Eastern Gas Board's stand at the Great Yorkshire Show held on its permanent showground at Harrogate was generally conceded the most ambitious and attractive that the Board have yet produced.

It was designed and built by the Board's central display and exhibition department and covered an area of 3,200 sq. ft. The site of the stand was between two main avenues thereby providing a through access from one avenue to the other.

It was decided, therefore, that really eye-catching facades were needed on both avenues. Much thought was given to this problem and a successful result was achieved by the combination of size, design and colour.

The attendance at the show was 85,720, a record for the present permanent showground.

Above: *The domestic side of the stand, though of simple concept, presented a most striking appearance, making use of colour as a foil to the latest gas and coke appliances.*

★

Right: *The industrial section of the stand featured the use of gas in poultry breeding and horticulture and an appropriate rural atmosphere was achieved by the use of colonnades stretching the full length of the industrial section of the stand. Part of the stand was given over to a display of coke burning equipment which included the 'Ideal,' 'Copperad' and 'Suxe' free-burning units and a range of domestic boilers, stoves and grates.*

GAS AND WATER THREATENED AT LOCHGELLY

Main Holder Leakage

A leakage of water at No. 1 holder at the gasworks at Lochgelly, Fife—main source of Lochgelly's gas supply—caused the holder to be put out of commission and emergency gas and water supplies introduced.

The reason for the leak has still to be ascertained, but it may be due to underground subsidence at the tank. Gas, water, and fire brigade authorities combined to solve an unusual and difficult problem.

When the trouble began a fire brigade detachment from Lochgelly was called to pump water to the leaking holder. When No. 1 tank went out of commission a smaller holder was brought into use. At times the pressure of gas had to be reduced because of the smaller holder.

YORK OIL GAS PLANT IS SUCCESSFUL

THE experimental 'cat-crackers' plant for producing domestic gas from oil at York gasworks has proved successful and is supplying 1 mill. cu.ft. of gas a day—enough to meet the needs of a town of 10,000 to 12,000 population.

'The plant, one of the first in the country, would in normal circumstances gasify 3,000 tons of oil a year, representing a saving of 8,800 tons of coal,' said Mr. H. Johnston, the N.E.G.B.'s Chief Engineer.

At the opening meeting, left to right: Mr. O. S. Brettle (District Manager), Mr. C. E. Williams (Divisional Sales and Service Officer), Miss M. Hill (Chairman), Mr. Stanley Jones (Divisional General Manager) and Miss P. Carter (Vice-Chairman).

Will This Idea Spread?

AN experimental club that might be called a junior branch of the Women's Gas Federation held its first meeting at Wolverhampton's gas demonstration theatre recently. Sponsored by the West Midlands Gas Board, the aims of the club—which is open to young women aged between 18 and 23—are directed towards helping such people understand home management, particularly where gas and coke might be involved.

There are to be cookery talks and demonstrations and competitions. The members—who at present total 40—are to study developments in homecraft, kitchen planning and design in the home. And the girls will be encouraged to use the club socially, as a place for discussion and exchange of views.

Mr. Stanley Jones, Divisional General Manager, with Mr. O. S. Brettle, District Manager, and Mr. C. E. Williams, Divisional Sales and Service Officer, attended the opening meeting.

Cork Gas Company Interim

An interim dividend at the rate of 3½% for the year ending December 31, 1956, was declared and made payable on August 31, 1956, by the Cork Gas Consumers' Company. Transfer Books are closed from August 21 to August 30, both days inclusive.

GAS SERVICES APPROVED BY COUNCIL

APPROVAL has been given by the Wantage (Berks) Rural District Council to the installation of gas services in houses under construction at Harwell and East Hendred.

Although the Southern Gas Board had at first intimated that a substantial contribution would be required from the Council towards the cost of laying the gas mains, they now stated that they were prepared to lay the main at their own expense and make a charge of £6 per house for laying the service pipes and providing four gas points in each house.

It was further reported that where the tenant chose gas for cooking instead of electricity there would be a saving of £8 on the cost of the cooker, and £2 11s. on the wash boiler, which after deducting the £6 charge of the Gas Board would result in a net saving of £4 11s. per house.

Shorter Week

AS a result of negotiations between the Scottish Gas Board and union representatives for a shorter working week for all day-shift workers in Scotland, about 400 of the Board's employees in Glasgow have started a five-day week as an experiment. It involves only a certain section of the day workers. They are still working a 44-hour week but finishing on Friday night instead of Saturday at noon.

CARNIVAL TIME AT BECKTON

BECKTON works and products works of the North Thames Gas Board staged an elaborate carnival for employees on July 21, culminating in a superb fireworks display. Wives, children and friends took part in or watched a sports meeting, a horticultural show, a 'fur and feather' show, the grand parade, a children's fancy dress competition, and a 'Miss Therm' beauty contest.

Out of eleven attractive girls the honour of being 'Miss Therm' went to 18-year-old brunette Miss Brenda Payne of Ilford. Mrs. L. W. Blundell, wife of the Board's Controller of By-Products, 'crowned' her.

Included in the sports programmes, which catered for everyone from tiny tot to veteran, were two sports association championships—a three-mile handicap, and a two-mile walk. These were won by V. Laver (Horseferry) and R. G. Andrews (also of Horseferry) respectively. Over 400 entries were exhibited at the horticultural show.

DRIVER CAMOUFLAGED COKE LOAD

'Quite Clever System' Earns Prison Sentence

A SCOTTISH Gas Board employee at Stirling gasworks, who evolved a camouflage system to defeat load checks on his lorry, was sent to prison for 30 days at Stirling Sheriff Court for stealing 39 tons of coke, valued at £234, from the Gas Board. He was William Dawson, 43, motor driver, of St. Ninians.

The fiscal said that Dawson had quite a clever system. Until recently, breeze, one of the by-products of the gasworks, had not been considered of any particular value and had been dumped as ashes in various places. The two hoppers—one containing coke and the other breeze—were situated next to each other.

Dawson, after loading up with coke at one of the hoppers then moved his lorry a little and proceeded to put a film of breeze over the coke. When his load was checked on the way out, it was taken as breeze.

The system could not be operated now as breeze was now considered to be of some particular value. It was estimated that Dawson had received £135 for the loads.

INTERNATIONAL GAS UNION MEETS IN ESSEN

The International Committee set up by the International Gas Union for the study of the interchangeability of gases met for the first time in Essen on July 30 and 31, under the chairmanship of Dr. F. Schuster.

Communications were made by M. Bolzinger and M. Delbourg (Association Technique de l'Industrie du Gaz en France), Mr. Fuidge (The Institution of Gas Engineers), Mr. Van der Linden (Vereniging van Gasfabrikanten in Nederland), Mr. Holmqvist (Svenska Gasverksföreningen), and by Dr. F. Schuster.

The members of the Committee visited the Gaswärme-Institut under the guidance of Dr. Schuster and the engineers of his staff. They were also conducted by Dr. Weittenhiller round the installations of the Steinkohle Gas A.G. in Dorsten.

Institution A.G.M. 1957—Date and Place

The 94th annual general meeting of the Institution of Gas Engineers will take place on May 14-17 at the Institution of Civil Engineers, Great George Street, London, S.W.1.

Catering Chief Retires

Making his farewell speech at a recent ceremony at Westminster is Mr. Arthur Long, Manager of the North Thames Gas Board's Catering Section who recently retired. For the past 20 years he has held this position, and altogether Mr. Long has been with the Board for 47 years, having started with them in 1909 as one of their first apprentices. Enjoying a joke is Mr. N. Junkison, Headquarters Divisional Manager, who presented Mr. Long with a cheque subscribed for by his many friends and colleagues. For Mrs. Long, who was not able to be present, there was the gift of a bouquet.

GASWORKS MAY CLOSE AHEAD OF SCHEDULE

THE Fife Group of the Scottish Gas Board decided recently to close down the Burntisland gasworks at the end of September and supply the town from a regional point in the county, but they may, through the action of the workers, have to close down much sooner. Twelve men are employed at the local works.

After talks between the Gas Board and trade union officials they were assured they would be given alternative employment at either Dunfermline or Kirkcaldy. A maintenance staff will remain at Burntisland.

When this decision was conveyed to the workers they refused to accept any of the jobs offered.

One of the stokers who has been employed at the works for 26 years said that all the men are leaving next week. He added that the job he was offered in Kirkcaldy was at a wage reduction of £3 5s. a week, and he would have had to pay his own travelling expenses.

The Enactment of the Clean Air Bill should result in East Kilbride being the first smoke-free town in Scotland, states the report of the East Kilbride Development Corporation. All the houses have been equipped with appliances for burning smokeless fuel, while all new factories are equipped with the most modern boiler plants.

During the Duke of Edinburgh's Study Conference a party of delegates, who came from industrial communities in this country and in the Commonwealth and Empire, visited the North Thames Gas Board's products works at Beckton. Sixteen delegates from about ten different countries were welcomed by Mr. R. N. Bruce, Deputy Chairman of North Thames Gas, who gave a short explanatory talk on the set-up of the Board. Mr. L. W. Blundell, the Board's Controller of By-Products, spoke of the processes carried out at the products works. The delegates were later joined by works and management representatives to discuss the rebuilding and modernisation of the products works.

SURGE CHARACTERISTICS OF TURBO MACHINES

and the Development of an Automatic Anti-Surge Device for Efficient Parallel Operation

By J. A. FERGUSON, B.E.M., A.M.I.Struct.E.

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IN the design of booster schemes for varying load conditions, the engineer must choose a size of machine which, within the circumstances of the distribution system, would operate at maximum efficiency for the longest possible period. In particular cases, one machine with a stand-by would meet requirements, but in most cases, where load variations cover a considerable range two or more machines capable of operating in parallel must be installed to meet these variations efficiently.

Some of the problems encountered in parallel operation are connected with the phenomenon commonly known as surge or pumping, a characteristic applicable to all turbo boosters irrespective of their make.

Though most engineers who have operated turbo machines have experienced this phenomenon, all will not have fully understood why the conditions arose, or what principles underlay the means they used for preventing or cancelling such conditions. First of all, therefore, it will be interesting to review the theoretical and practical aspects of this phenomenon, and that of the counter measures taken.

Under certain pressure volume conditions, surging or pumping takes place, and the machine begins to deliver gas intermittently. This immediately becomes apparent by the altering pitch of blade noise, fluctuations of the ammeter reading, if the compressor is electrically driven, or by the noise of the opening and shutting of the non-return valve.

Where only one machine is in operation, there should be no serious effect to the distribution system, other than a small variation in pressure, but it could be harmful to the installation itself, by causing damage to the thrust bearings and the non-return valve faces, if it is allowed to persist for any length of time. Generally booster operators are trained to take steps such as suction throttling, to counter the condition or prevent it from arising at all.

If, however, more than one machine is operating a serious disturbance can result if the phenomenon is not controlled.

Pressure Volume Relationship

So far, surging has only been referred to generally, but by studying a typical design curve for a turbo booster, the pressure volume relationship and the laws which underlie the phenomenon of surging, can be worked out.

Fig. 1 shows a pressure volume curve of a turbo booster at its normal and constant speed. This curve shows that the maximum volume of gas is boosted when there is no back pressure in the mains system, that is V_{max} at P_o. As the mains system fills up, the back pressure or resistance increases, and the volume of draw-in to the booster falls off.

If the characteristics of the distribution system agree exactly with the normal or design point of the machine as shown in the curve at P_n, the machine will, in due course, operate at this design point, that is, with a volume V_n and a pressure p_n. The pressure p_n does not represent the maximum potential of the machine, but this pressure, p_{max}, is indicated at point P_c on the curve. P_c, called the critical point, represents a volume pressure ratio which is related directly to the phenomenon of surging, or pumping. If the volume is reduced still further, that is, beyond the critical volume V_c the pressure begins to fall below the critical point until the point P_L is reached where the volume of intake has fallen to zero.

It would seem strange that the pressure should fall, and not rise when the volume is equal to zero, but, although the theoretical pressure volume curve, shown by AB in Fig. 1,

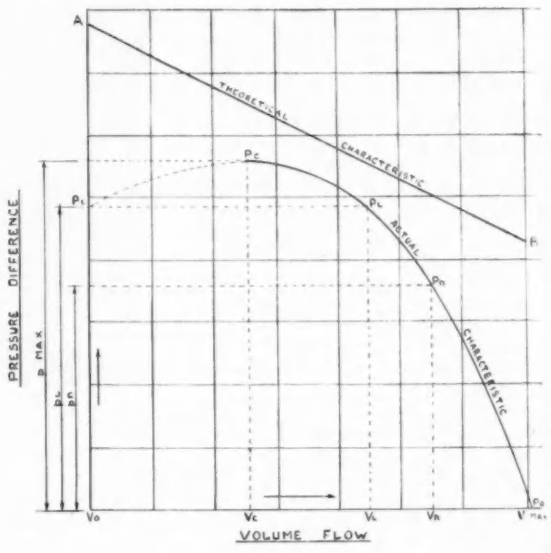


Fig. 1.

is a straight line, friction losses and impact losses when taken into account, give the actual curve of operation as represented by $P_L P_o$.

It can be seen then that if the machine has to operate at pressure and volume ratios to the left-hand side of this critical point, surging will take place, and this can only be offset by the introduction of special devices. Stable operation will, however, be obtained if the machine is operated within the range embraced by the falling portion of the curve to the right of P.

Reference must now be made to the law governing this critical point. Fig. 2 shows a typical set of characteristic curves, each curve representing a different speed, from top speed down to half speed; it indicates that the critical point is at the peak of each curve. The line joining these points is known as the surge line, and any point along the surge line is such that the ratio, pressure difference divided by volume squared, is approximately constant, i.e., $\frac{P}{V^2} = K$ or $P = KV^2$.

The value of the constant K varies with the particular design of the booster.

A study of the curves and the formula, show that conditions tend to approach surging point when P rises or V falls, or a combination of both, and so, to obviate surge, a relationship between pressure and volume must be maintained, which will ensure that the machine will operate to the right of the critical point P_c.

It can also be seen that as the speed is reduced, the critical volume becomes smaller, and the operating range, before surging is encountered, is increased. An advantage can therefore be gained by having a variable speed prime mover, and this is the most efficient means of minimising the possibility of surge conditions.

In Fig. 1 reference has been made to the normal point of operation or design point P_n, which means that the machine has been designed to boost at maximum efficiency a volume V_n at a pressure difference of p_n.

During the normal functioning of the whole of the distribution system, a state of balance is reached when its pressure, neglecting pressure losses due to flow, etc., is the same as the pressure at the booster delivery branch. At some periods, however, the demand for gas might be reduced or might even cease at certain sections of the distribution system, and if the speed of the booster is constant (which, of course, is common enough), the pressure at the compressor will rise according to the pressure volume curve. This means that the machine will be operating at high pressure, and low volume, and finally, if the demand for gas falls still further, the pressure p_{max} is reached.

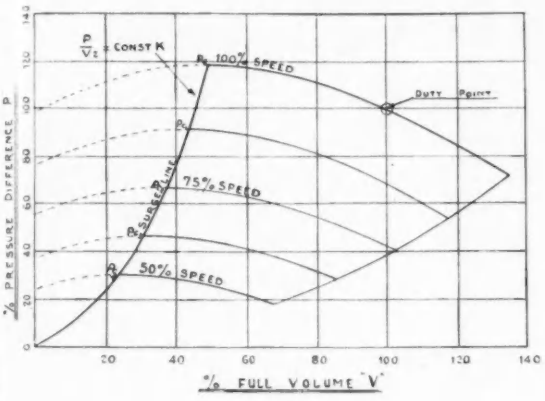


Fig. 2.

The booster, because it has no speed adjustment, is trying to get more gas into the distribution system than that system can absorb, with the result that the mains have become a kind of accumulator, and the pressure p_{max}, reached by the booster, is now the pressure in the mains system.

If the volume is still further reduced than that corresponding to the volume V_c against p_{max} the pressure at the outlet of the booster will also be reduced and be below that in the mains (reference to the curve will show this), with the result that there will be a back flow into the booster. At this stage the booster will suddenly cease to deliver gas and will in effect be operating at the No Load Point P_L, or, no volume at a pressure p_L.

As soon as the booster ceases to deliver gas the pressure will begin to fall, and when this pressure is equal to the No Load pressure p_L of the booster, it will suddenly begin to deliver gas again. The machine will in fact be operating now on the falling part of the characteristic curve at a pressure equivalent to the No Load pressure p_L, but with an indrawn volume of gas equivalent to V_L. This will be seen by reference to Fig. 1. However, as this new volume is still in excess of the gas demand, the same sequence of events is repeated. This process is generally summed up in the term 'hunting,' which means the consistent fluctuation of pressure and volume ratios, and as previously mentioned, is indicated by the change in the operational noise of the machine, and the continual movement of the non-return valve. This is an example of how surging occurs when one machine is in operation, but the difficulty is more pronounced when machines are operating in parallel and the sequence of events as they occur can be explained by referring to Fig. 3.

This shows the characteristic curves of two constant speed machines A and B, which though in theory are of identical design and capacity, have in practice differences in efficiency. This difference could be attributed to the slightest variation of weights and/or clearances of impellers and accentuated by differences in the connecting details, the inlet and outlet pipes, and valves.

The effect of surging is rather more pronounced when the machines are working in parallel due to inter-action between the machines, and it is this difference in characteristics which accentuates the incidence of surge when operating conditions are near the critical point. The difference in efficiency, however, is quite unimportant, when both machines are working on the right hand side of the critical point on the characteristic curve.

The two machines are operating at the mean duty point R_1 when (a) the demand falls off and the mains become an accumulator, or (b) the characteristic of the distribution system changes calling for higher pressure at lower volume, then the new mean duty point will be R_2.

This new duty point is the mean for the two machines, and its pressure value just coalesces with the critical pressure value p_c of the weaker of the two machines 'B.' When this point is reached machine 'B' begins to surge and ceases to deliver gas, and as a result the other machine 'A' is called upon to carry the whole of the combined load.

As the machine 'A' is unable to meet the same volume and pressure conditions as the two machines running together, its own duty point would move to the right along the curve towards a new point P_x, causing a fall in the mains pressure. As soon as it falls to the no load pressure p_L of 'B' machine, this machine will immediately cut in again, but at duty point P_L on the right hand of the curve and with an indrawn volume of V_{L_1}.

Both machines would then move up the curves again to mean duty point R_2. The cycle of events would be repeated, and prolonged and serious disturbance would result from this interaction between the machines.

If the movement of the machines towards duty point R_2 was caused by case (a) above, the operator may be able to shut down one of the machines completely, or else resort to outlet or inlet throttling, but if case (b) applied, where the duty point was in the vicinity of the surge or critical point P_c, prolonged and serious disturbance could result. Case (b) is quite common in the Glasgow Division, and no doubt applies elsewhere.

The adjustment of the inlet and outlet valves to control surge is relatively simple when only one machine is running, but can be difficult when two or more machines are running in parallel, and so the difficulties of the booster operator can be well imagined when he has two or three machines to control with the boosters and motors separated by a division wall. Under such conditions one machine may be throttled to such a degree that the other machine is overloaded and the motor cuts out.

Anti-Surge Control Measures

The anti-surge control measures which are taken might be divided under the following headings:—

Speed variation, suction throttling and by-passing. The first two methods do not completely eradicate surging, but if applied will reduce it to a considerable extent. The third method, however, can obviate the phenomenon entirely, although inefficiently.

The ideal distribution system is one in which there is a constant back pressure and which absorbs a constant volume of gas. For such a system a booster can be chosen with the appropriate normal operating point, and it would always work at maximum efficiency. In most distribution systems, however, there are considerable variations of pressure and flow, and so the design of the booster will be required to maintain volume and pressure characteristics as near as possible to the duty point of the system at any given time. If uncontrolled, the booster would continue to build up pressure in the main when demand is falling, and reach the critical point P_c shown on the curve, but control by either of the first two methods would only partially counter this tendency, and could not eradicate surging completely but such a condition could be met by a combination of methods one and two, when just sufficient gas would be by-passed between outlet and inlet to maintain the pressure differential P, and increase the total volume throughput to a value which satisfied the law $P = KV^2$.

The three methods of counteracting surge will now be dealt with in greater detail.

(1) *Speed Variation*

The effect of speed variation has already been referred to earlier on in some detail and it only remains to say that the operator should choose a speed to maintain district pressure requirements so that any variations would be well to the right of the point P_c on characteristic curve of the machine.

(2) *Suction Throttling*

Fig. 4 shows a series of curves where suction throttling is applied and its effect on the normal characteristic curve of the booster. Each curve is plotted for a fixed inlet pressure over the full volume range and the straight surge line P_c0 is similarly constructed. This condition would apply where the inlet pressure is maintained at a constant value by an automatic regulator, but in practice there would rarely be a definite curve of operation because of the necessity to adjust the throttle valve at each change of duty point of the distribution system. The curves as shown, however, will serve to point out the similarity between the results obtained by this method and the method of speed variation. Here also, surge can only be avoided if the duty point of the distribution system is to the right of the surge line P_cO. This method of control, however, is not as efficient as speed variation, because of the drop in inlet pressure caused by the restriction of the throttle valve.

(3) *By-passing*

This method, in its simplest form, is a means of ensuring that at no time will the volume of gas passing through the booster be less than the critical volume V_c. A quantity of gas is therefore passed from outlet to inlet, which, when added to that going to the district, will in total be not less than the critical volume. If efficiency was unimportant this method could ensure the total relief from surge conditions by simply leaving the by-pass valve open at a suitable position. Efficiency, however, cannot be ignored.

When Provan booster scheme was being designed in November, 1954, tests were being carried out at the Helen Street installation of three turbo boosters. The results of these and other tests convinced us that something more than adopted hitherto ought to be provided to counter surge, and it was considered that some system might be developed which combined the effects of speed variation and by-passing. This could be controlled automatically to provide an efficient system of counteracting surge without sacrificing the efficient operation of the boosters under varying load conditions.

Bryan Donkin Ltd., the contractors for both the Helen Street and Provan schemes, readily agreed to co-operate, and in due course produced a design which appeared to meet our requirements. A test rig was then built in their works and subsequent trials showed that the proposed device would operate satisfactorily.

Speed variation in itself is common enough, and in these installations was to be controlled by Bryan Donkin type regulators, which adjust the setting of the fluid coupling according to the speed, but the automatic by-pass control would have to work automatically at any speed that might be dictated by the speed regulator to meet district requirements. To make matters more difficult it must be remembered that at each speed setting there is a new characteristic curve with a new critical or surge point P_c.

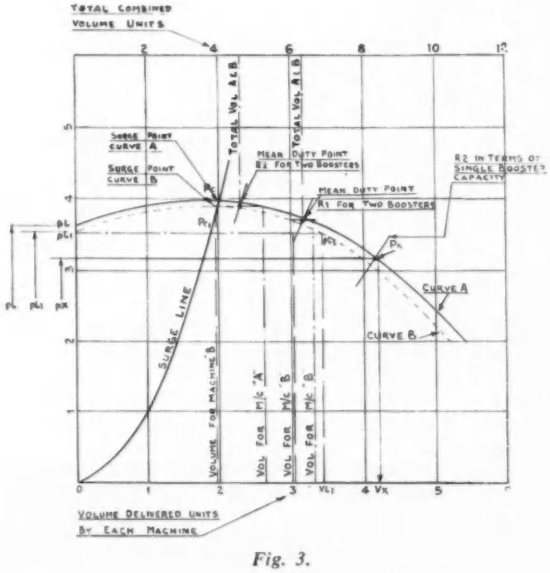

TOTAL COMBINED VOLUME UNITS
SURGE POINT CURVE A
SURGE POINT CURVE B
MEAN DUTY POINT R1 FOR TWO BOOSTERS
R2 IN TERMS OF SINGLE BOOSTER CAPACITY
CURVE A
CURVE B
SURGE LINE
VOLUME DELIVERED UNITS BY EACH MACHINE

Fig. 3.

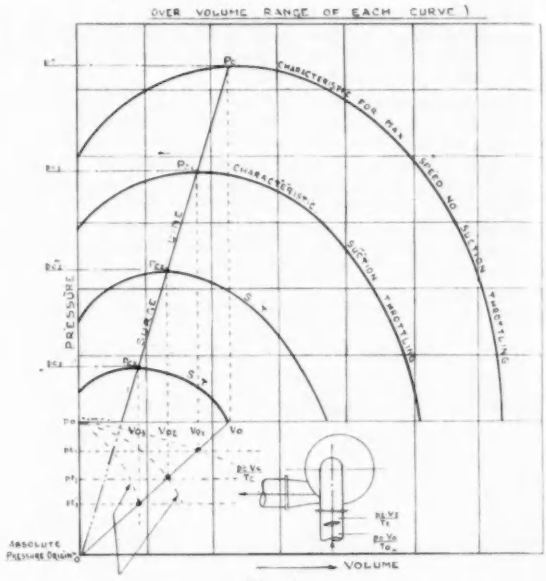


Fig. 4.

In view of the fact that the critical values of P and V vary according to the particular speed of the booster, operation of the governor must be related to the value of the constant K, and must integrate pressure and volume values as signalled from the boosters. And so whatever the booster speed may be, if $\frac{P}{V^2}$ exceeds the critical value K, (in fact if K falls below its design value) the governor will open and by-pass gas. This action increases the throughput of the booster and also the value of V^2.

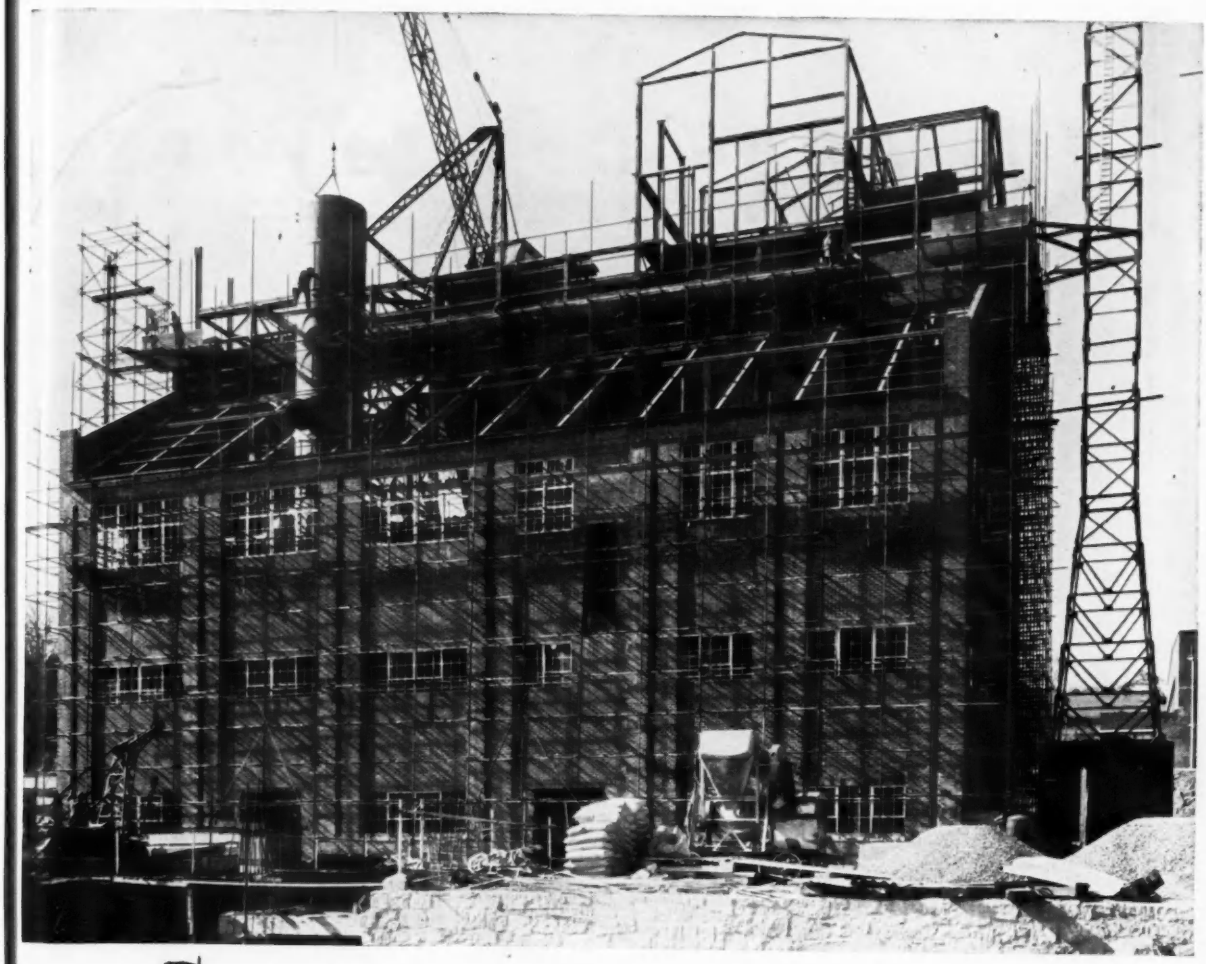
The governor cannot be controlled by changes in the value of V only because V varies according to the speed, and would necessitate the governor being re-set at every change in speed. A state of affairs which is impracticable.

Fig. 5 shows a diagrammic layout of this governor.

Tappings from the inlet and outlet connections of the compressor are taken to the pressure chamber C in which the pressure will be differential pressure P across the compressor. The orifice plate E is situated at the compressor inlet and the pressure drop h across this orifice is proportional to V^2. The upstream and downstream tappings of the orifice plate are taken to chamber D in which the pressure will therefore be the differential pressure h across the orifice. The forces exerted in the chambers C and D, due to pressures P and h, are supplied to the ends of a sensitive balance. The leverage about the balance pivot of the force exerted in chamber D can be varied by control screw G and the setting would therefore be in accordance with the value of the constant K, which varies with the design of the booster.

If a particular duty point dictated by the demands of the distribution system is considered, first the automatic speed control would set the booster at its proper speed by means of the fluid coupling, and then as the duty point might fall within the surge zone the anti-surge governor would commence to operate.

The greater leverage about the balance pivot exerted by chamber C, controlled by pressure differential P, tips the balance over and closes the micro switch F_1. This starts up the small electric motor which drives the disc B through a worm reduction gear. Disc B by opening the by-pass valve A allows a larger volume of gas to flow through the compressor, and in this way increases $\frac{P}{V^2}$. The butterfly valve continues to open slowly until $\frac{P}{V^2}$ reaches its surge line value when the balance arm falls back into its balance position, and opens the pressure switches F_1 which stops the electric motor operating the butterfly valve. Should the duty point change so that $\frac{P}{V^2}$ is outside the surge zone, the balance arm will then tip in the opposite direction closing the micro switch F_2 which rotates the motor in the opposite direction and slowly closes the butterfly valve until the balance position is again reached.



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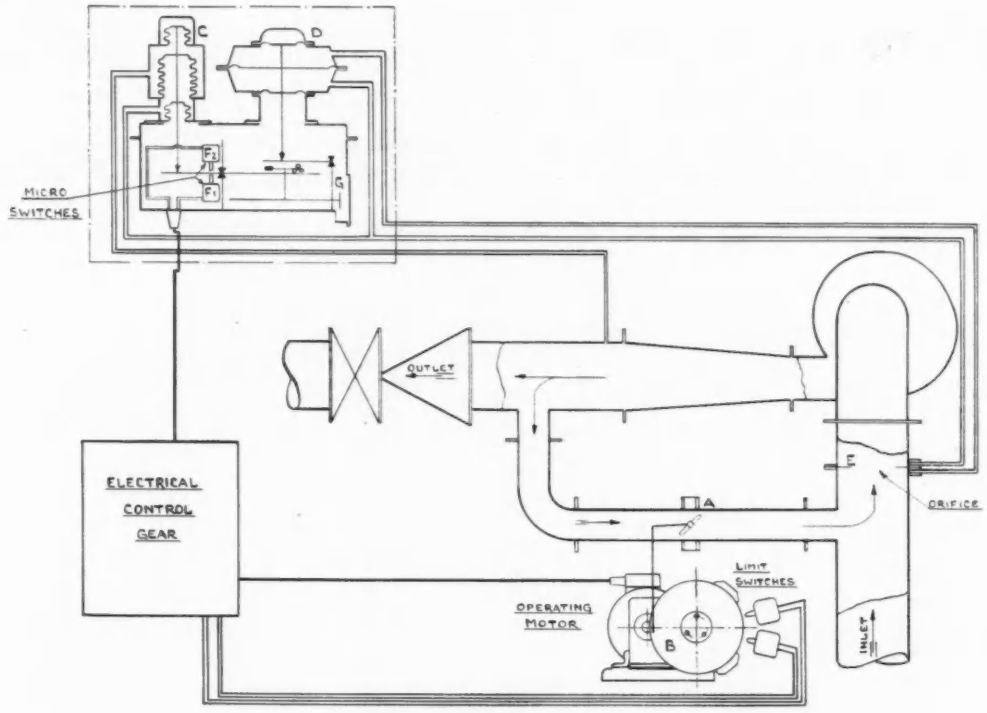

Fig. 5.

A timer is included in the electric circuit with a 30 second cycle and during each cycle the motor operating the by-pass valve can be arranged to run for a period of from 0 to 15 seconds, depending on requirements, the actual time being fixed by the angular setting of the two timer cams with respect to each other. The object of the timer is to slow down the governor operation during the closing process and so minimise hunting. Limit switches are fitted to the by-pass valve operating mechanism to prevent damage in the event of the circuit becoming faulty, and also to stop the operating motor when the by-pass valve is in the fully closed position.

The above device will operate in conjunction with the other automatic controls which we have specified for the Provan installation.

The scheme comprises three turbo boosters, each capable of pumping 750,000 cu.ft. of gas per hour at a pressure differential of 6 lb. with a space left for the possible addition of a fourth machine in the future. The machines will be driven through speed increasing gears by 500 h.p., high tension squirrel cage motors, and speed variation will be controlled by a Vulcan Sinclair fluid coupling in conjunction with the anti-surge governor.

The boosters may be brought into operation in a desired sequence according to the quantity of gas required. This control is operated from an orifice plate in the main inlet manifold and the differential across this orifice plate will operate pressure switches which will cut in or cut out the motors as the case may be. The number of boosters in operation is therefore dictated by the volume of gas to be boosted and not by the pressure differential across the booster. This ensures that the booster motors are protected against over-load.

The above method of control should simplify the operation of the boosters over the whole range of gas requirements for the district's distribution system, particularly when the machines are called upon to operate in the surge zone.

COKE SHORTAGE FORECAST

A *Financial Times* Correspondent, in a communique from Luxemburg, reports that a shortfall of about 400,000 tons of coke in the third quarter of 1956 is a feature of the general forecast of operations released by the High Authority of the Coal and Steel Pool. The report states that this seems likely to occur in spite of the increase to nearly 8 mill. tons in the import of coal from the U.S.

The supplies of American coal will be about 2 mill. tons above the rate of import in the beginning of the year, half the increase being for France and 700,000 tons for Germany.

The estimated coke shortage allows for a fall of 50,000 tons in stocks which, however, at 435,000 tons are so low as to represent a negligible reserve.

Pithead stocks of coal at 6.7 mill. tons are also unduly low. Of the total, 5.3 mill. are in France and four-fifths of the French stock consists of unsaleable low-grade coal. Of the estimated pool consumption of 62.4 mill. tons of coal during the third quarter 1¼ mill. tons will go direct to the steel industry and 24.9 mill. tons to the coke ovens. Of the coke production of 18¾ mill. tons about 11¼ mill. tons will be for the steel industry.

Demand for steel in the third quarter seems likely to show no great change, says the report. If exports are again in the region of 2½ mill. tons enough steel should be available to cover the estimated consumption of 11.8 mill. tons. The balance could, however, easily be disturbed by any major change in the external demand or in the rate of internal stockpiling. The continuation of high imports of scrap has kept the position in hand. There was some increase in mill stocks during the second quarter and prices are steady except for a slight fall in France.

The decision to waive import duties on pig-iron as from July 1 is a factor contributing to ease the supply position. It is noted that in the first quarter of this year the Pool was net importer of pig-iron, excess imports being 85,000 tons. This excess is expected to rise to 200,000 tons.

The report reiterates the warning that it is only an increase in pig-iron production which can in the long term liberate the Pool from its dependency on the international scrap market, from which imports in the third quarter are estimated at 700,000 tons.

Steel making during the period is expected to take 10 mill. tons of pig-iron and 5.3 mill. tons of scrap.

D

NATURAL GAS AND THE WORLD POWER CONFERENCE

Abstracts of two papers dealing with the long-distance transmission of natural gas which were read at the World Power Conference.

1. Economic Requirements

By J. J. HEDRICK,

PRESIDENT, NATURAL GAS PIPELINE COMPANY OF AMERICA.

IN most instances, long-distance pipelines were established to meet an economic need for natural gas service in areas where natural gas had once existed locally but had become in short supply, and other areas where the economy and desirability of using such fuel were apparent. The demand for natural gas service has increased tremendously in recent years, as indicated by the increase from 11.78 mill. in 1946 to 23.61 mill. in 1953 of customers using natural gas in whole or in part, while the number of manufactured gas customers decreased from 8.73 mill. to 2.79 mill. in the same period. This service is now being extended to every section of the nation.

Almost 90% of the estimated proved recoverable natural gas reserves in the United States are located in a comparatively small area in the southern, south central, and southwestern parts of the country, at a considerable distance from population centres. Long-distance pipelines therefore provide the only means by which this nation-wide market for natural gas can be served.

The total mileage of natural gas pipelines in the United States, excluding distribution mains and field lines, increased from about 77,000 miles in 1945 to more than 125,000 miles in 1953, with an average annual increase of more than 6,300 miles in the last four years of that period. At the end of 1953 there were 21 long-distance natural gas pipeline systems in the country, each more than 500 miles in length, with a maximum daily capacity varying from 220 mill. cu.ft. to 1,910 mill. cu.ft. and, in addition, there was one integrated system having a total of 8,040 miles of transmission mains with a maximum daily capacity of 4,181 mill. cu.ft. Many of these systems have since been expanded; one new pipeline 850 miles in length, with an initial daily capacity of 375 mill. cu.ft., was recently placed in operation; and two other major systems are now under construction, one of which will extend about 1,800 miles through the Rocky Mountains to the Pacific Northwest area.

Experience in the establishment of pipeline systems of such magnitude, and in their successful operation, both economically and in quality of service rendered, indicates certain economic points of view which should be given attention.

Gas Supply in Relation to Market Demand

All interstate pipeline companies in the U.S.A., before undertaking the construction and operation of new or additional facilities, attaching new customers, or increasing deliveries to existing markets, must submit to the federal regulatory authority reliable estimates of their market requirements, and show availability of a gas supply reasonably adequate to meet such requirements for approximately 20 years. Adherence to this requirement not only gives assurance of adequate and continuous service, but also provides evidence of soundness and stability requisite to attracting capital investment necessary for the undertaking.

The basic economic requirements for the establishment and operation of long-distance gas supply systems are the same, regardless of (a) the type of gas transported, (b) the geographical location of the system, and (c) whether the gas is to be transported for sale, for the transporter's own use, or for another. Such economic requirements also should be the same whether the system is established and operated (a) wholly by private enterprise, subject to or free from governmental regulation, (b) wholly by governmental authority, or (c) by private enterprise under government subsidy. For purpose of discussion these basic requirements may be grouped under the general subject of (a) markets, (b) gas supply, (c) design, and (d) financing.

Markets

The primary economic requirement is, of course, a market for the gas to be transported. Such a market must be adequate as to quantity, as to quality and as to duration; it must be such as to permit successful competition with other fuels and sources of energy; and, it must be located within a reasonably economic distance from source of supply.

The area proposed to be served must provide a market of sufficient size and duration to justify the large investment required and, importantly, the demand for service must continue to an extent sufficient to assure normal payout on the investment. There should be a balance between the classes of customers to be served (i.e., residential, commercial, industrial—using gas for fuel, and industrial—utilising gas in special processes) and a balance between the character of service to be rendered (i.e., firm, interruptible, and seasonal), which will permit maximum operation on both a daily and an annual basis with resulting minimum unit cost of operation.

Normally, the introduction of gas service into any particular area will occasion at least partial displacement of other fuels or sources of energy then in use. Since inter-fuel and inter-energy competition does not adhere to fixed relationships where alternatives are made available which offer varying appeals in price and quality, factors affecting such competition should be given consideration, both in initial planning and in forecasting the ability of the gas system to operate economically.

The geographical location of the market to be served in relation to the source of gas supply has a direct effect upon investment required and costs of operation. Experience in the U.S.A. shows, however, that length of the pipeline system may be limited only by the extent to which other economic requirements for its establishment and operation may or may not be fulfilled. Detailed engineering and cost studies of a proposed natural gas pipeline to extend 2,500 miles from the Middle East oil fields to Paris, France, with an initial daily capacity of 500 mill. cu.ft. and ultimately one billion cu.ft., demonstrate that distance from source of supply to market is of itself no economic barrier to establishment and operation of a long-distance system. Those studies made in 1951, indicated that the gas could be delivered in Paris at a maximum price of 32 cents per thousand cu.ft., and it was concluded that the large population and price of competitive fuels would give an assured market, with additional opportunity for industrial expansion in fields not possible with other fuels.

Whether a particular area proposed to be served will provide a market for gas of sufficient size and duration to justify the large investment required, whether the service to be demanded will be sufficiently balanced as to classes of customers and character of service to permit economical operation, and whether there can be successful competition with other fuels and energy sources in the area can be determined only after the making of a careful, detailed, and thorough market survey. Such a survey, competently made and providing a thorough analysis of the proposed market, is essential in undertaking the establishment of a long-distance gas supply system.

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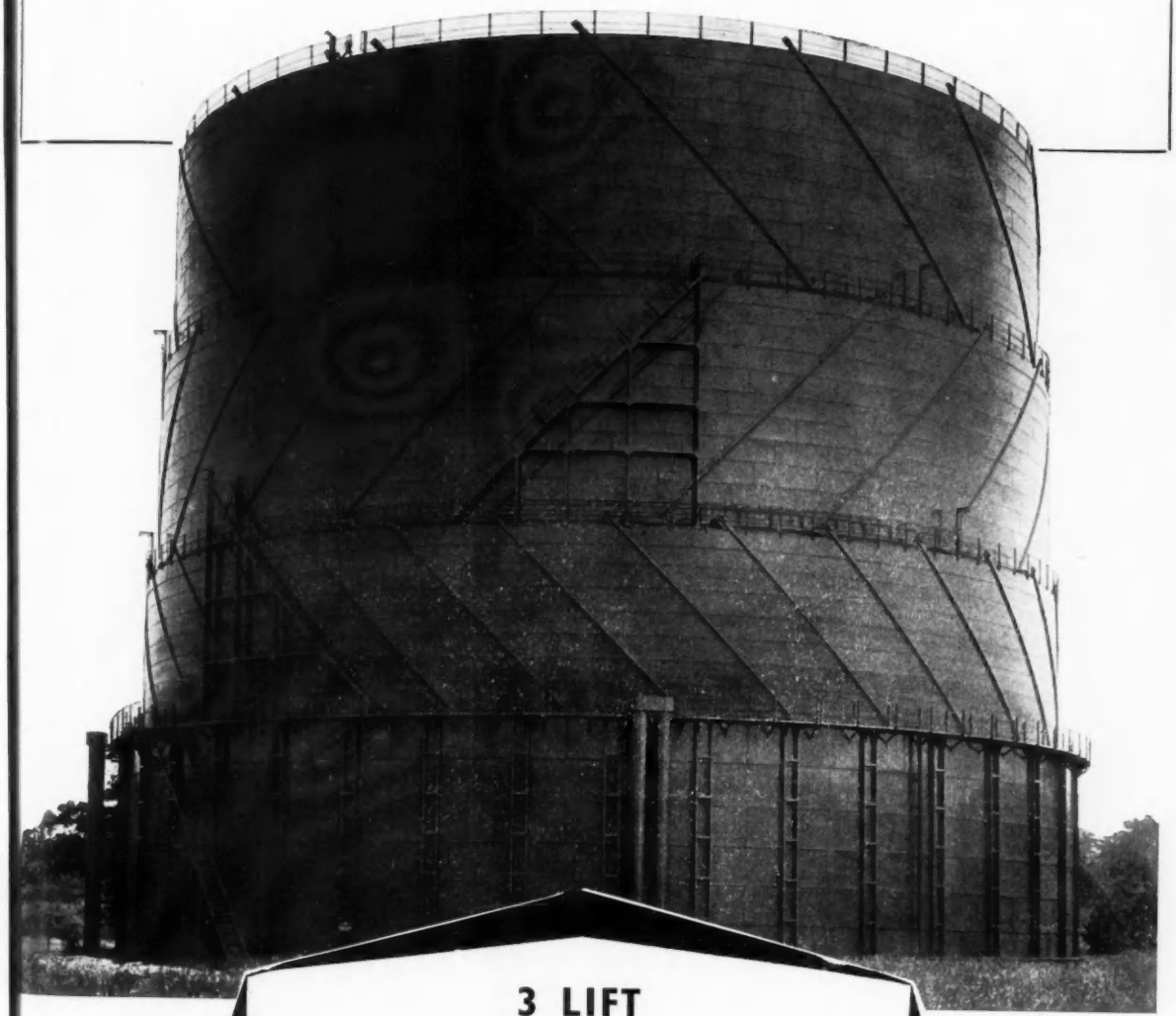

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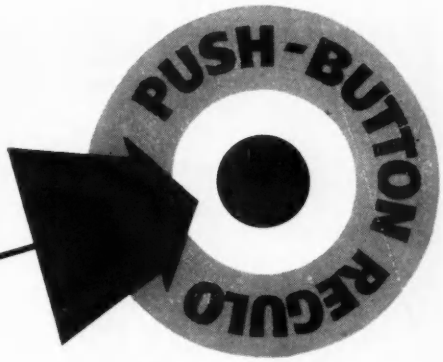

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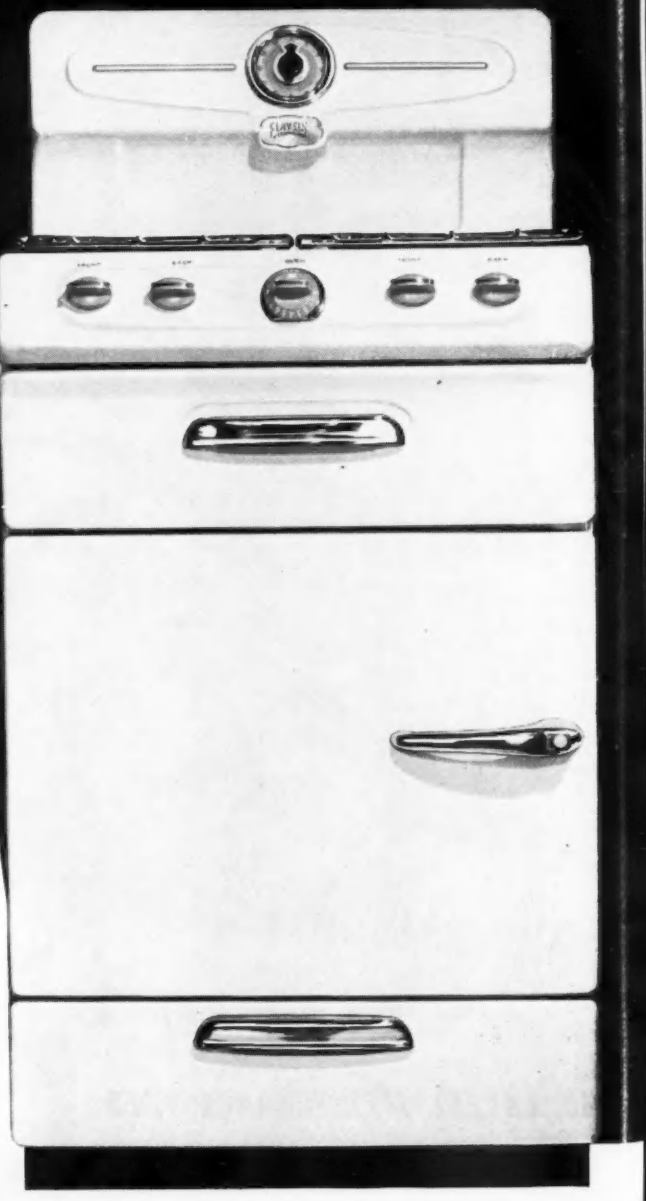

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Obviously, the supply of gas for a long-distance pipeline system must be available in sufficient quantity to meet daily and annual market and pipeline system requirements for the life of the project. This does not mean, however, that the total quantity required for the entire period should be obtained initially before commencement of operations; to do so would in many instances be both impractical and uneconomic. Diversity in source of supply as to location, kind of gas, and ownership and control is desirable, since it affords opportunity for most efficient adjustment in day-to-day operations between available supply and pipeline requirements, thus conserving the overall gas supply to the fullest extent possible. Diversity of location, particularly of natural gas reserves, also places the pipeline operator in a more favourable position to acquire additional supplies since he will be able to provide a ready market for new gas as it is discovered.

The quality of the gas to be transported, particularly as to heating value and necessity for purification prior to transportation or use, should be given careful attention. If the gas is to be sold or used in a manner that the thermal content enters into determination of the unit cost to the ultimate consumer, thereby directly affecting the price to be charged and revenues to be received by the pipeline operator, effort should be made to obtain a gas supply with the highest heating content possible, since the cost of transporting a cubic foot of gas through a pipeline is the same regardless of its thermal content. The purification and treatment of gas prior to transportation and use adds to costs of operation of the system, and therefore should be given consideration.

The geographical location of source of supply in relation to the market to be served should be considered since it may require a routing of the pipeline through terrain of such character that costs of construction and operation may be far in excess of normal costs. Similarly, the gas supply may be so located that it is accessible only by means of special pipeline construction at comparatively high cost. Examples of such conditions existing in the U.S.A. are gas fields so located that the pipelines must be constructed over high mountain ranges, and gas production many miles off shore in the Gulf of Mexico which requires laying of pipelines under water, using specialised construction technique and materials.

Underground storage facilities, operated as an integral part of a long-distance gas pipeline system, permit the most economical utilisation of both source of supply and pipeline facilities, as has been clearly demonstrated by experience in this country.

Design

It has been stated, based upon a study of statistical data of long-distance pipelines in this country, that the basic economic principles which govern the construction, selection, and operation of natural gas pipelines fall into these three major concepts:

1. For a given pipeline diameter, the delivery cost per unit increases almost directly with the length of the line.
2. The volume capacity rises more rapidly with increased diameter than the increased cost per mile. Hence, the larger the line diameter the lower the unit cost, at capacity volume.
3. The delivery cost per unit varies with the percentage change in load factor. The percentage variation in unit cost is about the same for any given load factor for any given length pipeline, regardless of diameter.

The design engineer is primarily concerned, however, with the basic principle that for any specified volume of gas to be transported there is one combination of pipeline diameter, operating pressures, and compression ratios, which will result in the most economical system. The engineer has control over these basic factors of size, pressures and compression ratios, and their proper selection will provide optimum design with annual costs being maintained at a minimum.

Additional design factors over which the engineer has no control, and which must be given consideration, include:—the origin, terminus, and, except for minor deviations, route of the pipeline, giving particular consideration to the nature of the terrain to be traversed, the character and extent of the market to be served, the character and extent of the gas supply, the volume of gas to be transported, physical characteristics of the gas to be transported, including necessity for purification and treatment, construction costs and cost of materials, costs of obtaining funds required during construction, and governmental or industry imposed regulations.

The proper selection of design factors may be made through use of a large number of calculations involving the use of various values for the several factors to determine the best combinations.

Economic problems of evaluating load growth also are of vital interest to the engineer in determining proper design. This may be demonstrated by an example: A pipeline approximately 1,000 miles in length, requiring deliverability of 300 mill. cu.ft. daily, may be designed either as a 24-in. dialine operating at 1,000 lb. per sq. in. with compressor stations approximately 80 miles apart, or as a 30-in. pipeline, operating at 800 lb. per sq. in. with compressor stations about 240 miles apart. Each of such designed systems will show approximately the same cost of service. However, the 24-in. pipeline has been so designed that it will be powered to its economic optimum, leaving little or no opportunity for expansion, whereas the 30-in. pipeline may be economically developed by additional compressor stations to a capacity of about 550 mill. cu.ft. daily. Possible future expansion of the initial system must therefore be considered in every instance, if optimum economic design is to be obtained.

Ability to finance the proposed project is a requirement for the establishment of any long-distance gas supply system. The great expansion of the gas industry in the United States in recent years attests the economic soundness of the financing methods there utilised.

Operation of Long-Distance Gas Supply Systems

The economical operation of a long-distance gas pipeline system is related directly to (a) Revenues required to meet total operating costs of the existing system, and to provide for replacement, modernisation, and expansion of existing facilities, and (b) seasonally fluctuating market demands. In addition, the physical plant must, of course, be operated in an efficient manner, and further, where competition exists, a competitive selling price must be maintained under competitive service conditions.

The total expenses of operating a gas pipeline system include (a) original investment cost which, on an annual basis, constitutes the fixed charges, and (b) annual operating expenses. Fixed charges represent the minimum annual sum which will pay a sufficient annual return to attract capital and permit recovery of investment cost during lifetime of the installation. Such charges will be proportional to the investment.

Economy in operation also requires expert forecasting of sales, expenses, and revenues, careful preparation of and conformity with annual budgets, and continual long-range planning, giving consideration to all factors affecting markets, gas supply, plant expansion, and general economic conditions.

Economical operation is directly related to the large investment required and the fluctuating nature of the market demands for the gas. The investment depends primarily upon the volume of gas to be delivered on the maximum day, and the distance over which the gas is to be transported. Total operating costs for the system are nearly constant whether all or only part of its capacity is utilised, and the cost of transportation on a unit volume basis is therefore almost inversely proportional to the load factor. Economic operation therefore requires that the load factor shall be maintained at a point sufficiently high to assure the lowest unit volume cost.

The annual load factor of a gas pipeline system is a composite of the load factors of each of the several classes of service. The percentage range of load factor for the several classes of natural gas service in the United States has been stated to be: (a) Residential general—75-85; (b) commercial general—75-85; (c) residential and commercial space-heating—23-28; (d) small industrial—60-75; (e) large industrial, firm—60-75; industrial, (f) interruptible—none.

It was at one time believed in the U.S.A. that in the colder climates, where high house-heating saturation may exist, only by selling large volumes of gas to industrial users on an interruptible basis at low or competitive prices could a high system load factor be achieved and residential and commercial customers be served at a reasonable cost. This view has been subjected to these criticisms: (a) The effect of system load factor upon cost of delivered gas is pronounced in the lower ranges up to about 60%, but is progressively less as the load factor approaches 100%. (b) Within broad limits, the dia-

meter of a high pressure gas pipeline has a more important effect upon transportation costs than does the load factor attained in its operation. (c) Where there are markets for firm industrial gas service at commensurate prices, a company may be in better position by their selective development at a load factor of 60 to 70%, than at a higher load factor which might be achieved by selling at low prices for inferior interruptible service. (d) Whether interruptible industrial gas may be sold sufficiently to increase the load factor to a point deemed desirable is almost entirely a matter of price. (e) Experience has shown that it may be impossible to serve the large volume of interruptible industrial sales up to 60% of annual sales which would be required to maintain a system load factor of 100%. (f) The opportunity for developing year-round industrial markets appears to be almost unlimited, and it should not be difficult to maintain a 60 to 70% system load factor with year-round industrial sales even without peak-shaving or terminal storage.

Peak-shaving is a method of meeting sudden increased demands for gas service for a very short period of time. It ordinarily is undertaken either by a utility customer of the pipeline company through use of otherwise idle manufactured gas facilities, liquified petroleum gas installations, or conventional gas holders, or by the ultimate gas consumer with gas standby equipment. In any event, peak-shaving is not a particularly effective method of improving or increasing the system load factor of a large pipeline system, since it provides a limited supply of gas of very short duration, opportunity for utilisation is very limited, and the high unit cost makes its use for such purpose rather uneconomic.

Underground storage of natural gas is the only type of storage sufficient to level annual load variations. Generalised recent unit costs for investment per thousand cu.ft. of gas for the several types of storage facilities have been given as follows:

Underground storage, $0.40; liquefaction, $20.00; high pressure bottles, $50.00; gas holders and sphere, $175.00-$250.00.

Storage of gas in excavated caverns through mining operations also has been proposed, and economic studies indicate the comparative unit cost for investment per thousand cu.ft. for such storage might possibly be as low as $0.50.

The contribution of underground storage to the more economical operation of a pipeline system has been discussed above.

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2. The Italian System

By Dr. Ing. RAFFAELE GIROTTI,

SOCIETA NAZIONALE METANODOTTI, MILANO.

DURING the prewar period, natural gas production in Italy was almost entirely limited to the eastern area of the Po Valley (Polesine) where a great number of wells had been drilled at small depths (an average of 500 m.). In the centre of the valley with the exception of a few discoveries of minor importance such as Fontevivo, Bellena, Podenzano and San Giorgio Piacentino, results had not been very encouraging. In 1946, when the immediate postwar crisis was overcome, Agip discovered the Caviaga field at about 35 km. southeast of Milan, where at a depth of 1,400 m. natural gas was found at a pressure of 150 Atm.

These results showed the possibilities of an accumulation in the Upper Miocene of the Po Valley and were the beginning of an intensive and extensive series of researches which led to the subsequent discoveries of Ripalta and Cortemaggiore in 1949, Cornegliano in 1951, and so on.

Already in 1947, just after the discovery of Caviaga, the reserves of which were estimated at about 10,000 mill. cu. m., the problem of marketing the production of the first wells drilled had become urgent.

Up to that time the small-scale production of natural gas was utilised for automotive uses to take the place of gasoline and was being transmitted through a 3½ in. dia. pipeline to several stations located in Lodi, Milan, Piacenza, Parma, Reggio Emilia and Salsomaggiore, where it was compressed to 200 Atm., in steel bottles. At first it was decided to utilise completely the capacity of the small diameter line and so in June, 1947, the first industrial plant was connected. At the same time, while an elaborate transportation and distribution plan was being studied, the design and construction of a natural gas pipeline with an approximate 500,000 cu. m. per day capacity was started, following an agreement with 'Dalmine,' the most important Italian pipe manufacturing company, to connect the Caviaga field with the Dalmine plant near Bergamo. At the end of 1948 the line began operating and the factory started to use natural gas.

In the meanwhile the foundations were being laid for the study market survey for the long distances gas transmission programme.

Market Survey

On the basis of the solid and liquid fuel allocations given to industries in 1947 by the Board of Trade and Industry (Northern Italy Sub-Committee) it was possible to ascertain the industries' solid and liquid fuel demands, consumption concentrations, and their geographical location.

The result of the study was that 70% of energy consumed for industrial uses in all Italy had been absorbed by northern industries and it was furthermore seen that 2% of the consumers absorbed about 50% of overall requirements and that in Lombardy, the area nearest the fields, there were the greatest percentage of industries with a consumption far above the other areas. There were four large consumption concentrations respectively, in the Milan, Turin, Genoa and Porto Marghera areas.

Owing to the particular territorial distribution of potential consumption, the layout of the transmission system to be adopted according to the location of the fields discovered, was clear: A large horizontal trunk line from the field area to Turin and Porto Marghera, one or more trunk lines to Milan and the industrialised areas to the northwest and northeast; another trunk line to Bologna and one to Genoa. The fields would be connected together by gas pipeline allowing natural gas to be switched from one field to another.

Naturally, in the northern section of Lombardy a greater number of pipelines would have to converge because of the greater density of consumption.

According to the plan studied by Snam, secondary lines branching out from the main lines would form local networks.

The resulting transmission system closely followed the original plan and was developed almostly entirely, with the exception of only a few modifications and covered an area of approximately 25,000 sq. km. with extension of between 2,000 and 3,000 km., having a maximum capacity of about 25 mill. cu. m. per day.

Economics and Technique of Natural Gas Transmission in Italy

Although American experience was undoubtedly useful as a general guide it certainly did not apply in our particular case as the Italian technical and economic conditions were quite different.

Besides the enormous differences in the two countries of the ratios between the various sources of energy, the difference of the industrial and economic structure, the consumption concentration and respective locations of production sites and utilisation areas, all put the Italian problem under aspects that were the opposite of those in the United States.

In a transmission problem the technical-economic set-up is definitely influenced by the factor 'distance' together with the factor 'quantity.'

Whereas in the United States, the distance of production sites from points of consumption is generally over 1,000 km., flow rates in the order of 10 mill. cu. m. per day, and the problem of intermediate compression along the line is essential. In Northern Italy with maximum distances of 200 km., and flow rates of a few million cu. m. on major pipelines, there was no problem about intermediate compression, and the technical-economical planning of the natural gas pipeline was based on determining the most convenient diameter.

First it was established that, steel with an ultimate tensile strength of 55 kg. per sq. mm. and a yield point of 34 kg. per

sq. mm., allowed an operating pressure with a minimum weight of steel of between 50 and 60 kg. per sq. cm.

The limiting distances beyond which the pressure drop, determined by starting pressure, could not be utilised, and therefore would require intermediate compression, were also determined for Italian operating conditions and Italian costs, for each rate of flow.

The limit-distance varies from a minimum of about 200 km. for a flow rate of 800,000 cu. m. per day to a maximum of about 500 km. for 5 mill. cu. m. per day.

Gas transmission in Northern Italy, under the above-mentioned conditions of distances and flow rates, did not justify intermediate compression.

Calculations were made to determine the economic diameter and minimum weight and so the total cost of pipe between two delivery points.

It was possible to plot the relationship between transmission line cost and its weight as the latter is proportional to the square of the inside diameter. The cost index could be therefore expressed in relation to flow rate, length, and initial and final pressures of each pipe section.

In the economics of transmission of every form of energy the load factor also plays an important part.

It must be borne in mind at the same time that the difference between summer and winter load factors to certain consumers not only limits the quantity of gas which can be potentially delivered during the year, but also the extension of the supply to a greater number of customers.

Peak-Shaving

The problem of peak shaving, which is particularly apparent in the United States because of the high percentage of residential users, has found various solutions of a technical and economic nature, such as underground gas storage in depleted gas fields near consumption centres, storage in pressure vessels, storage of liquified natural gas, the employment during peak periods of oil gas or L. P. G. mixed with air, the stipulation of interruptible contracts with industry. These are all means adopted to achieve the most constant deliveries of gas from transmission lines.

Generally speaking, the application of such precautions has resulted in the United States natural gas pipelines having a load factor between 80% and 95%.

Naturally all such methods are not similarly applicable in all cases as some require particular technical and local conditions and others are based on special economic factors which vary with each location and installation.

The necessity of regulating future consumption was considered most urgently in Northern Italy after the early period of development of the gas transmission and distribution system.

Those consumers which affect the overall annual consumption most unfavourably are peak steam-electric plants and residential consumers. The first because they limit operation to a period of six or seven months between September and March, the second, with an average ratio of 1 to 7 between summer and winter consumption.

This situation causes considerable disturbance to the entire pipeline deliveries which varies between winter maximum peaks and summer minimum consumption in 1954 in the ratio of 4.5 : 1.

Provisions directed towards correcting irregularities determined by technology of processes and utilisations, or by weather conditions or by customary practices, obviously cannot alter the nature of things, but may instead effect distribution, according to a compensation programme.

Whereas underground storage of gas in Northern Italy would not resolve the general problem of winter peaks because of the dispersion of consumption centres, the possibility of interrupting supply to major industrial consumers who are in position to profit by fuel oil standby service or able to use alternate fuels without inconvenience, would effectively contribute towards balancing winter peaks.

In large cities, oil gasification could contribute to the natural gas supply, while in smaller centres the overnight gas accumulation in controlled ratio to day consumption might be useful.

Finally, the acquisition of summer seasonal consumers, such as sugar works, preserved foodstuff plants, as has already been experienced, would improve the seasonal load factor of natural gas pipelines.

These problems which have both technical and economic importance for gas transportation and distribution are now being studied.

It is obvious that the examination of the various technical and economic aspects leads to the evaluation of the 'utilisation value' of natural gas by different consumers.

The 3,800 km. Italian natural gas pipeline system, of which 96% has been constructed, is operated by companies of the E.N.I. group and today serves all the most important centres of Northern Italy.

Approximately 3,000 km. of gas pipelines with a transmission capacity of 20 mill. cu. m. per day belong to Società Nazionale Metanodotti of the E.N.I. group, which practically controls all natural gas transportation and distribution in Northern Italy. Over 700 km. are under construction or planned and will be added to in the near future to improve the connections with the new fields and to further develop the expansion programme.

The construction technique and materials employed are not substantially different from those already adopted in the United States of America, but it must be stressed that the different urban and geographical conditions in Northern Italy have caused many problems which required particular solutions specially where safety measures are concerned.

If one considers that density of population reaches 280 inhabitants per sq. km. in some of Northern Italy's areas, with over 900 in the province of Milan and 400 in the province of Varese, it is quite easy to understand the difficulties that had to be overcome not only in the choice of layouts and general design, but above all in construction. Often it was impossible to follow the most convenient routes, or, for reasons of safety low pressures were adopted even in rural areas instead of the high pressures which would have been desirable.

The difficulties encountered in carrying out such an important work have been numerous, but the encouraging results achieved from the spreading in Italy of natural gas utilisation are a reward for all the preliminary efforts, and a stimulus to the accomplishment of further advances in the production, transmission and distribution.

Natural Gas Contribution to Italian Economy

Since 1948 to date, the contribution of natural gas to the Italian energy budget has been ever-increasing.

Comparing 1954 energy consumption (in terms of fossil coal) with those of 1948 it is important to note that, while total requirements increased by 76% natural gas consumption increased about 2,700% passing from 117,000 to 3,271,000 equivalent tons, covering 7.94% of the 1954 energy requirements against 0.05% of 1948. These consumptions, designed to increase further as the numerous new fields are discovered by the State Agency and extension of the transmission and distribution system is increased, will reach about 4 mill. equivalent tons in 1955 and 4.8 mill. in 1956, corresponding to a value of about 50,000 mill. liras of imported coal. (Conversion factor natural gas to coal 1 : 12).

As already mentioned, the uses of natural gas have undergone a thorough evolution from being a substitute of gasoline, to that of a fuel for industrial and residential use.

Considering demands of the last few years, it is highly probable that a further expansion will take place.

By examining percentage distribution of utilisation from 1952 to 1954 it appears obvious that natural gas in Italy will assume an ever more important rôle in sections which can use it to the best advantage.

Gas Utilisation in Italy

	1952 %	1953 %	1954 %
Industrial uses	75.9	70.3	65.0
Chemical (raw material)	1.3	4.1	7.0
Steam-electric power plants	6.9	11.7	13.6
Residential uses	5.5	6.5	8.1
Automotive	10.4	7.4	6.3
	100.0	100.0	100.0

Even if, as is anticipated, the basis of consumption continues as a fuel for industry, the natural gas for the production of energy increases there will be greater utilisation of it in the chemical conversion industry.

It is most interesting to observe how in such a short time the picture of availability and distribution of sources of energy in Italy has changed. Everything moved ahead so very rapidly and now the discovery of major natural gas fields already belongs to the past.

THE DEVELOPMENT OF THE 'DIAMOND' CREMATOR

by

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ASSISTANT INDUSTRIAL GAS OFFICER, W.M.G.B.

IN an endeavour to obtain an improved cremator that would more nearly meet the desires and objectives of the cremation movement, experimental and development work has been proceeding at the Golders Green Crematorium, London, for some years.

This work has been carried out by the industrial staffs of the West Midlands and North Thames Gas Boards, in full collaboration with Mr. H. D. E. Carter, Superintendent, Golders Green Crematorium, and Assistant Managing Director of the London Cremation Co., Ltd., and his staff. The project was initiated by Mr. G. le B. Diamond, Chairman of the London Cremation Company, who has been closely associated with the cremation movement for many years. Included in the terms of reference in connection with the design of the cremator were the following:—

1. That the cremator should positively and completely eliminate the emission of smoke.
2. That cremation should be carried out speedily and completely.
3. That the cremator should be economical in gas consumption, be simple to operate, and require the minimum of maintenance.
4. That the cremator should be finished externally to comply with the æsthetic requirements of a modern crematorium.

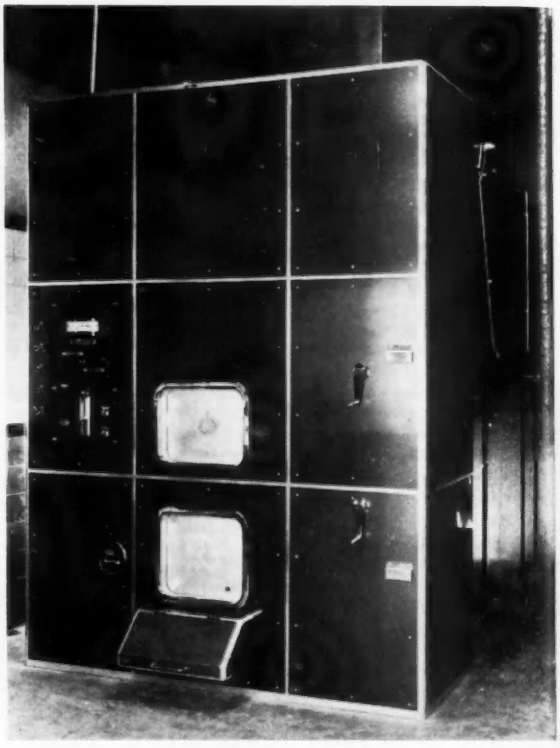
The first prototype cremator was designed by the late Mr. J. F. Waight and Mr. G. le B. Diamond and constructed at Golders Green. This incorporated recuperation, *i.e.*, preheating of the air supply by the outgoing waste gases, by the conventional medium of passing them over a bank of specially treated steel tubes, fitted above the arch, together with a system of neat gas firing. This first design did not fulfil the desired objectives but it did provide very valuable information on the merits of recuperation, and on the advantages to be derived from various types of burner equipment which lead to the construction of a second prototype cremator. This final design has, in a period of seven months, dealt with 1,026 cremations in an average time of 48.5 minutes and with an average gas consumption of 669 cu.ft. per cremation, the lowest consumption per cremation being 286 cu.ft.

Advantage of Insulating Refractories

Recuperation is not practiced in the final prototype, an important feature in the design from a thermal engineering aspect being the selection of refractories to give a low thermal capacity. The main advantage to be derived from the use of 'insulating refractories' lies in the fact that the cremator very quickly attains the requisite temperature to enable cremation to be properly carried out with a minimum fuel consumption.

While there are variations in temperature throughout each cremation, the temperature 'swing' on the last cremation is not different to any marked extent from that on the first cremation. This is important as it means that the cremating conditions are fairly uniform within the furnace chamber, irrespective of hours of operation. Thus, in the not-too-busy crematorium, one or two cremations can be carried out economically and efficiently, while in the busy crematorium operating conditions do not change as the day proceeds. The latter point is made because in the older type of cremator the first and second cremation times were invariably prolonged, due to the delay in attaining cremating temperature, while as the day wore on and the cremator temperature increased, it also became increasingly difficult to avoid smoke emission. Maximum temperature recorded is approximately 1,100°C.

On the subject of smoke emission: This is carefully looked after in the new design in that air is supplied to special combustion chambers in such quantities that there is a reserve, even when dealing with the worst 'smoke offender,' *i.e.*, the pitched coffin, to ensure that combustion of this smoke is positive and complete, and that it takes place where the heat release can be usefully employed.



Rear view of the 'Diamond' cremator.

The burner equipment has also received particular attention, the burners in the main chamber being located in the arch, firing downwards. Special flame stabilisation tips are fitted to ensure stable combustion at all times.

A heat-resisting steel hearth is employed with spacings that allow only the ashes to fall through to a carefully designed dished ash collecting hearth. A separately heated ash refining chamber, equipped with powerful air blast burners, is also provided and this serves, over a period of 3-4 minutes, effectively to reduce any residual wood ash and to whiten the fine residue. The ashes then fall through from this refining hearth to an air-cooled chamber where they are cooled before finally being withdrawn.

The cremator is simple to control, push rods, conveniently located on a panel at the rear being employed to give independent control of each burner, while the main under-hearth air supply is controlled by the operator by simply pressing an 'increase' or 'decrease' button, this action opening or closing an extrically-operated reversing motor-controlled valve in the air supply.

The cremator is also provided with simple controls which ensure that the operator cannot commence to light up the cremator until the air blowing fan is running and all individual burner gas control taps are in the closed position. Finally, the appearance of the cremator is of considerable importance. The prototype unit is equipped with a streamlined casing with anodised and stained aluminium panels which can be varied in colour to suit individual requirements. The development work referred to, and also that carried out by the North Eastern Gas Board, in conjunction with the Lawnswood Crematorium, has resulted in two new gas-fired cremators being available, with a very much improved performance over the older types of cremator, with positive elimination of smoke emission.

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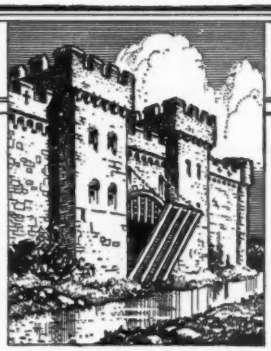
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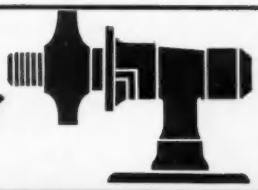

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PUBLISHERS' NOTICE

The " Gas Journal " is published every Wednesday, price **1/6d.**; by post **1/8d.**

Subscription Rates: Home and Empire:—**60/-** per annum; Foreign:—**70/-** per annum. (Both payable in advance.) A copy of the " Gas Journal " Calendar & Directory is presented each year to continuous subscribers.

Classified Advertisements: All small classified advertisements are charged at **2/6** per line (approx. **7** words)—minimum charge **10/-**. A Box Number address occupies **2** lines, and a further **6d.** is charged towards cost of postage on replies. Copy must be received by first post on Monday to ensure insertion in that week's Journal.

Displayed Advertisements: Rates obtainable on application to the Business Manager. Change of copy for displayed spaces must be received **14** days prior to publication if proofs are required. Type area of inside pages **10** in. deep × **7** in. wide; block screen **120**.

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NORTHERN MANAGER: Philip W. B. King, Flat 1, 7 Langcliffe Avenue, Harrogate. *Telephone:* Harrogate 67625.

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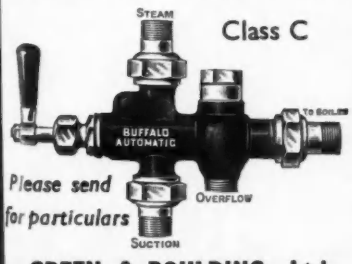

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APPOINTMENTS VACANT

SOUTH WESTERN GAS BOARD

BRISTOL/BATH DIVISION
SENIOR TECHNICAL ASSISTANT—AVON STREET WORKS

APPLICATIONS are invited for the above position. The successful applicant will be placed within Grade IX (£755-£855) or Grade X (£820-£920) according to experience and ability. Associate Membership of the Institution of Gas Engineers is a desirable qualification and the holding of a Higher National Certificate in Mechanical Engineering will be an advantage.

The Manufacturing Plant consists of Horizontal Retorts and Water Gas Plant.

A good flat in a very desirable residential area is available at a reasonable rent.

Applications, addressed to the undersigned, should be received not later than August 31, 1956.

CHARLES R. INGHAM,
Production Engineer and Manager.

Radiant House,
Bristol, 1.

July 27, 1956.

NORTH WESTERN GAS BOARD

WIRRAL GROUP
DEPUTY GROUP INDUSTRIAL GAS ENGINEER

APPLICATIONS are invited for the above pensionable appointment at a salary within Grade A.P.T. 12 (£900/£1,025 p.a.).

Applicants should have a wide experience in the operation and design of industrial gas appliances or have considerable experience in heat process work and a knowledge of the application of gas and other fuels in industry. They should be Corporate Members of the Institution of Gas Engineers or hold a suitable technical qualification or university degree.

Applications should be made on the appropriate form, obtainable from the General Manager, N.W.G.B., Wirral Group, Hind Street, Birkenhead, and should be returned to him within 14 days.

(*Classified advertisements continued on page* 418)

APPOINTMENTS VACANT (ctd.)

WEST MIDLANDS GAS BOARD

WOLVERHAMPTON AND DISTRICT DIVISION
STATION ENGINEER, SEDGLEY

APPLICATIONS are invited from corporate members of the Institution of Gas Engineers for this appointment, carrying responsibility to the Station Engineer at Dudley for the operation of a works producing about 160 millions cubic feet annually in Woodall-Duckham vertical retorts.

The salary will be within A.P.T. Grade 10 (£820-£920 per annum) of the salary scales of the National Joint Council for Gas Staffs.

The post is pensionable, and the successful candidate may be required to pass a medical examination.

Applications stating age, qualifications and experience, together with names of two referees, should be addressed to the Industrial Relations Officer, West Midlands Gas Board, 6, Augustus Road, Edgbaston, Birmingham, 15, to reach him not later than August 20, 1956.

J. C. INGRAM,
Secretary to the Board.

WEST MIDLANDS GAS BOARD

VACANCY FOR SENIOR PHYSICIST
AREA LABORATORIES

APPLICANTS should possess a university degree in physics and have had experience in the application to industrial processes of a wide range of instruments and should be capable of developing the use of instruments in gasworks processes.

The occupant of the post is required to advise on the installation and maintenance calibration of instruments throughout the Area, and is responsible for the maintenance and calibration of laboratory instruments.

The salary of the post will depend on the experience and qualifications of the successful candidate. The appointment is pensionable and may be subject to the passing of a medical examination.

Applications stating age, qualifications and experience, together with the names of two referees, should be addressed to the Industrial Relations Officer, West Midlands Gas Board, 6, Augustus Road, Edgbaston, Birmingham, 15, to reach him not later than August 20, 1956.

J. C. INGRAM,
Secretary to the Board.

WEST MIDLANDS GAS BOARD

WARWICKSHIRE DIVISION
LEAMINGTON SPA AND WARWICK DISTRICT
SENIOR TECHNICAL ASSISTANT

APPLICATIONS are invited for the above position at a Works having a production capacity of five million cubic feet of gas per day.

Candidates should hold the Higher Grade Certificate in Manufacture of the Institution of Gas Engineers. They should possess practical experience of the operation of vertical retort installations, C.W.G. plant and normal gas works ancillaries, and should be experienced in carrying out all usual gas works tests.

The salary will be within A.P.T. Grade 7 of the National Salary Scales for Gas Staffs (£670-£750 per annum). The post is pensionable, and the successful candidate may be required to pass a medical examination. A house will be available at a reasonable rental.

Applications stating age, qualifications, and experience, and giving the names of two referees, should be addressed to Mr. A. Allen, Divisional General Manager, West Midlands Gas Board, Warwickshire Division, Gas Street, Coventry, to reach him not later than August 20, 1956.

J. C. INGRAM,
Secretary to the Board.

EAST MIDLANDS GAS BOARD

SHEFFIELD AND ROTHERHAM DIVISION
ASSISTANT CHEMISTS
CENTRAL LABORATORY, SHEFFIELD

APPLICATIONS are invited from suitably qualified persons for positions as ASSISTANT CHEMISTS in the Central Laboratory, Grimesthorpe Works, Sheffield.

Salaries will be in accordance with Grades APT. 5/6/7 (£575/£750) of the National Salary Scales, and initial placing thereon will be dependent upon qualifications and experience.

Candidates should be experienced in the analysis of coal, coke, oil, gas and by-products.

The persons appointed will be responsible to the Divisional Chemist for the organisation and control of sections of the laboratory work and should possess the Higher National Certificate in Chemistry, or equivalent.

The positions are pensionable, and the successful applicants will be required to pass a medical examination.

Applications, giving details of age, qualifications and experience, together with the names and addresses of two referees, should be forwarded to reach the undersigned not later than Monday, September 3, 1956.

C. C. WOOD,
Commercial Street, Divisional General Manager.
Sheffield, 1.

EAST MIDLANDS GAS BOARD

LEICESTER AND NORTHANTS DIVISION
DISTRIBUTION ENGINEER—WELLINGBOROUGH GROUP

APPLICATIONS are invited for the post of DISTRIBUTION ENGINEER, Wellingborough Group. The appointment will be made within Grades APT. 11/12 (salary range £850/£1,025), and the salary at commencement will be dependent upon the qualifications and experience of the person appointed.

Applicants, who should possess the Higher Grade Certificate in Gas Engineering (Supply) of the Institution of Gas Engineers, or its equivalent, must have had considerable experience in a modern Gas Distribution Department and should be competent to supervise systems involving the use of low, medium and high pressure mains with district holders.

The Distribution Engineer, who will be required to reside in or near Wellingborough, will have overall responsibility for the distribution function within the Group, which comprises the Wellingborough, Rushden and Kettering/Corby districts with approximately 45,000 consumers. He will also be responsible for Holder Stations and general property repairs and maintenance in the Group.

The post is pensionable, and the successful applicant will be required to pass a medical examination. Applicants stating age and giving details of education, qualifications and experience, together with the names of two referees, should be addressed to reach the undersigned not later than September 8, 1956.

H. B. TAYLOR,
Gas Offices, Divisional General Manager.
Millstone Lane,
Leicester.

NORTH THAMES GAS BOARD invites applications from CHEMISTS, who have obtained a First or Second Class Honours Degree, for vacancies at its Chemical By-Products Works, BECKTON, EAST HAM, E.6, for research on problems in connection with coal tar distillation, and the manufacture of phenols, naphthalene and bases.

Preference will be given to those who have had some post-graduate experience in research particularly in subjects related to those mentioned above.

These are permanent appointments and offer good prospects of advancement.

Successful candidates will be required to join the Staff Pension Scheme. Starting salaries will be according to age and qualifications.

Applications, giving age and full details of training and qualifications, should be addressed to the Staff Controller, North Thames Gas Board, 30, Kensington Church Street, W.8, to reach him by not later than 14 days after the publication of this advertisement, quoting reference 666/288.

NORTH EASTERN GAS BOARD

HEAD OFFICE
ENGINEERING ASSISTANTS

APPLICATIONS are invited from suitably qualified persons for two posts in the Chief Engineer's Department at the Head Office of the Board.

(a) ENGINEERING ASSISTANT.—The duties include, either in whole or in part, the preparation of schemes, estimates and specifications for all types of Gas Works ancillary plant including gas transmission machinery and equipment. Candidates must have good drawing office and general engineering experience. Preference will be given to applicants possessing a Higher National Certificate or the equivalent.

(b) ENGINEERING ASSISTANT (CIVIL).—Candidates should have had experience in the design and detailing of reinforced concrete, steel frame superstructures and foundations, and in the preparation of drawings and specifications for civil engineering projects.

The salary for both posts will be within Grade A.P.T. 9 (Provincial 'A') (£755-£855 per annum) of the Salary Scales agreed by the National Joint Council for Gas Staffs.

The successful applicants will be required to pass a medical examination and to join the Board's Staff Pension Scheme.

Application forms may be obtained from the Chief Engineer, North Eastern Gas Board, Head Office, Bridge Street, Leeds, 2, and should be returned to him not later than August 28, 1956.

J. C. GARDNER,
Secretary.

SENIOR SCIENTIST required in N.C.B.'s Directorate of Scientific Control at London Headquarters. The work is concerned with the direction and co-ordination of research and investigations carried out in the Divisions on problems connected with the carbonisation of coal in coke ovens, and the recovery and treatment of by-products. A good honours degree in science or chemical engineering and research experience are required. Experience in the carbonisation, petroleum or heavy chemical industries is desirable. Appointment (superannuable) within inclusive range £1,800-£2,100 male, according to qualifications and experience.

Write, with full particulars of age, education, qualifications and experience to National Coal Board, Staff Department, Hobart House, London, S.W.1, marking envelope SS/369 before September 3, 1956.

SCOTTISH GAS BOARD

SOUTH EAST DIVISION
DISTRICT MANAGER—GRANGEMOUTH

APPLICATIONS are invited for the post of DISTRICT MANAGER, Grangemouth. Candidates, who should be corporate members of the Institution of Gas Engineers, or possess an equivalent qualification, must have administrative experience in addition to a sound and extensive knowledge of modern methods of gas manufacture in vertical retorts and C.W.G. plant and in distribution.

The salary attached to the post will be Group 6 of the Senior Officers' National Salaries Table (£1,025-£1,145 per annum). A house will be available at a reasonable rent.

The position is pensionable, and the successful applicant will be required to pass a medical examination. Applications stating age and giving particulars of education, training, experience and qualifications should be addressed to the undersigned to arrive not later than Monday, August 27, 1956.

D. J. COLVIN,
Divisional Controller.
25, Chester Street,
Edinburgh, 3.

PLANT FOR SALE

FOR SALE.—Ex Stock—Electrostatic Precipitator by Simon-Carves Ferranti to 40,000 volts—3 Milliamps D.C. Unused or very little used. Can be viewed in Manchester—£1,250. Address: No. 2[illegible] *Gas Journal*, 11, Bolt Court, Fleet Street, London, E.C.4.

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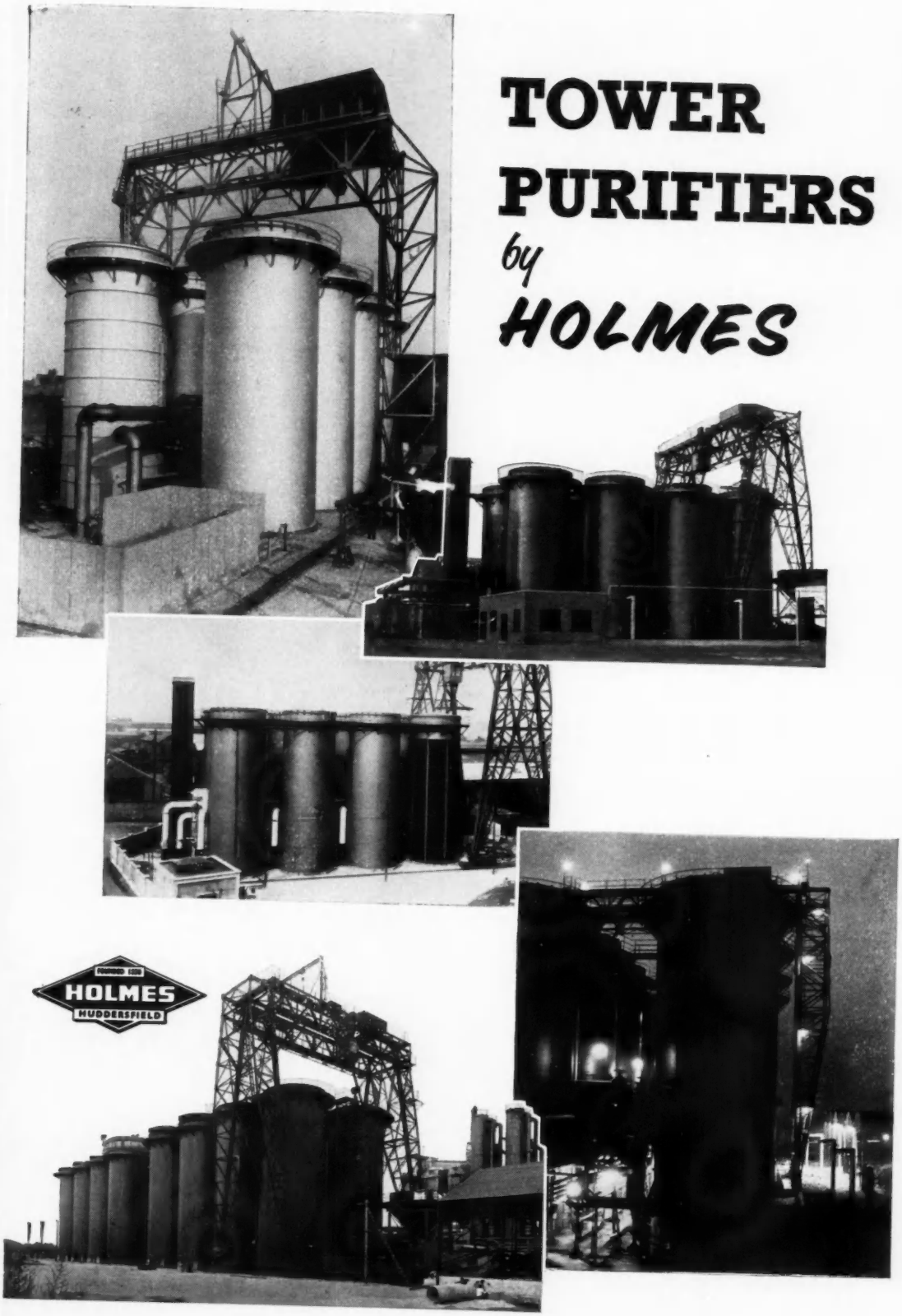

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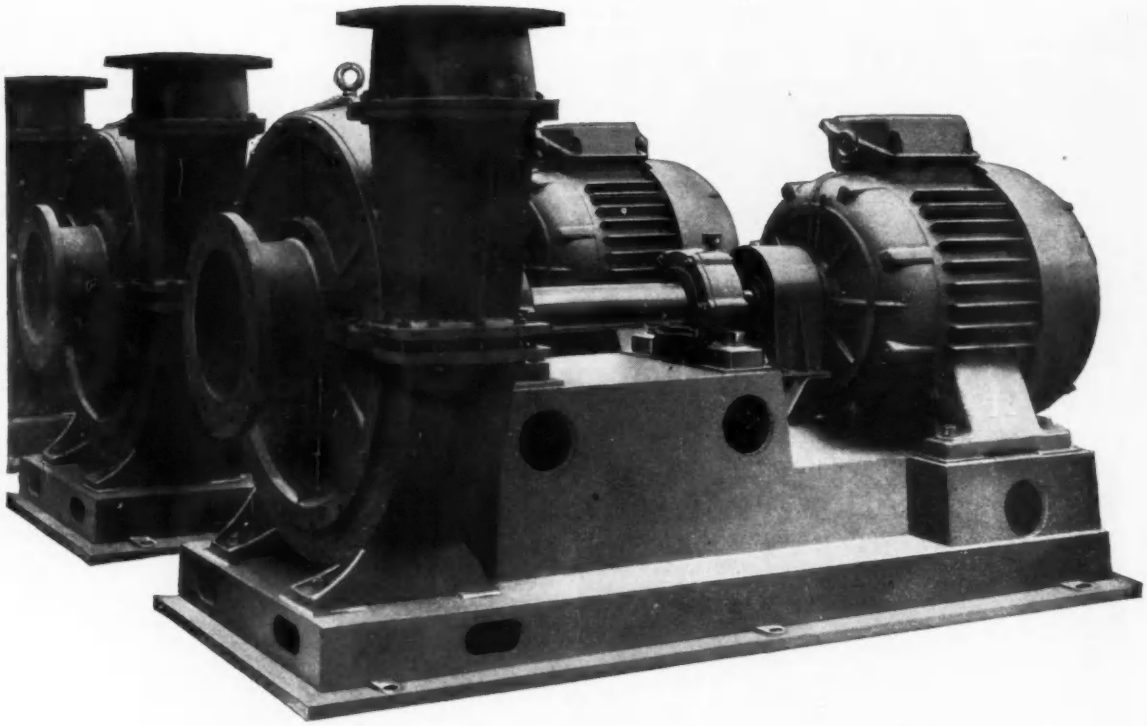
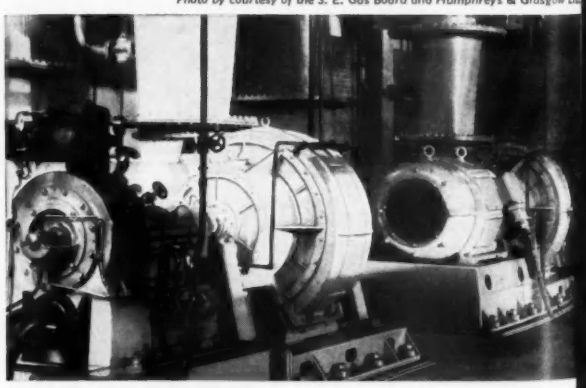


Gas Boosters?

Photo by courtesy of the S. E. Gas Board and Humphreys & Glasgow Ltd.



EXAMPLES of gas boosting fans with cast iron casings are illustrated here. They represent the results of special attention to the design and development of robust, trouble-free boosters over the years. This experience provides fans for handling volumes of 5,000 to 1½ million cubic feet of gas per hour at pressures up to several pounds per square inch.
When the time comes you'll find there's no easier way to solve your air or gas moving problem than to put it to Keith Blackman.

contact **Keith Blackman Ltd**

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Two sides to the question . .

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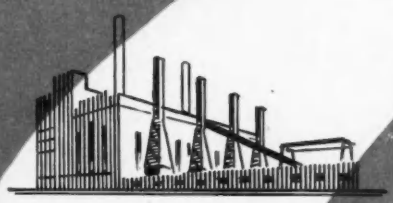
OR INTERMITTENT



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Long life

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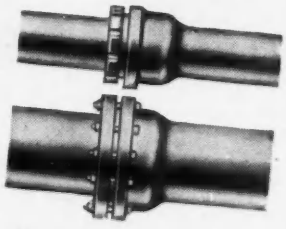

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